Downloaded from http://www.everyspec.com

INCH-POUND

MIL-DTL-12133E
19 October 2105
SUPERSEDING
MIL-W-12133D
17 June 1994

DETAIL 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 (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-1907	Inspection, Liquid Penetrant and Magnetic Particle, Soundness Requirements for Materials, Parts, and Weldments

(See supplement 1 for list of specification sheets.)

(Copies of these documents are available online at http://quicksearch.dla.mil/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

Comments, suggestions, or questions on this document should be addressed to DLA Troop Support - Industrial Hardware Division (ATTN: Code FHTE), 700 Robbins Avenue, Philadelphia, PA 19111-5096 or email trpsptspecspa@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil .

Downloaded from http://www.everyspec.com

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ASME-B18.18	Quality Assurance for Fasteners
ASME-B46.1	Surface Texture(Surface Roughness, Waviness, and Lay)

(Copies of this document are available from www.asme.org American Society of Mechanical Engineers, Three Park Avenue, M/S 10E, New York, NY 10016-5990.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A380/A380M	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A684/A684M	Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled
ASTM B194	Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar
ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM E384	Standard Test Method for Knoop and Vickers Hardness of Materials
ASTM E1444/E1444M	Standard Practice for Magnetic Particle Testing
ASTM F1470	Standard Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

(Copies of these documents are available from www.astm.org or the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

NATIONAL AEROSPACE STANDARD (NAS)

NASM1312-6	Fastener Test Methods, Method 6, Hardness

(Copies of this document are available from www.aia-aerospace.org or the Aerospace Industries Association, 1250 Eye Street, N. W., Suite 1200, Washington DC, 20005-3924.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS5519	Steel, Corrosion Resistant, Sheet and Strip 18Cr – 8Ni (SAE 30301) Cold Rolled, 185 ksi (1276 MPa) Tensile Strength - UNS S30100
SAE AMS5528	Steel, Corrosion-Resistant, Sheet, Strip, and Plate 17Cr - 7.1Ni - 1.1Al Solution Heat Treated, Precipitation Hardenable - UNS S17700
SAE AMS5906	Steel, Corrosion Resistant, Sheet Strip 18Cr - 9.0Ni (SAE 30302) Cold Rolled, Full Hard, 185 ksi (1276 MPa) Tensile Strength - UNS S30200
SAE AMS5913	Steel, Corrosion-Resistant, Sheet and Strip 19Cr - 9.2Ni (SAE 30304) Cold Rolled, Full Hard, 185 ksi (1276 MPa) Tensile Strength - UNS S30400
SAE AMS-C-81562	Coatings, Cadmium, Tin-Cadmium and Zinc (Mechanically Deposited)
SAE AMS-QQ-P-416	Plating, Cadmium (Electrodeposited)

(Copies of these documents are available from www.sae.org or the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

Downloaded from http://www.everyspec.com

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification Sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. 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. The washer material shall meet the following requirements.

3.2.1 Spring steel. Spring steel washers conform to any 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 SAE AMS5906, or Type 17-7PH (UNS S17700), per SAE AMS5528.

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

3.2.4 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

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 plating. When specified, washers shall be cadmium plated in accordance with SAE AMS-QQ-P-416, Type II, Class 2 or SAE AMS-C-81562, Type II, Class 2 for electrodeposition or mechanical deposition, respectively (see 6.4).

3.4.2 Zinc. When specified, washers shall be zinc plated in accordance with SAE AMS-C-81562, Type II, Class 2 or in accordance with ASTM B633, Fe/Zn 12, Type II for mechanical deposition 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/A380M.

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.

Downloaded from http://www.everyspec.com

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 ASME B46.1.

3.8 Decarburization. Spring steel washers shall be free from 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 4.4.3.7.2, 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. VERIFICATION

4.1 Conformance inspection. Conformance inspection shall consist of all the examinations and tests specified herein.

Downloaded from http://www.everyspec.com

4.2 Inspection of product for delivery. Inspection of product shall be in accordance with the requirements of ASME B18.18. Final inspection shall consist of Groups A and B inspection as specified in this document.

4.2.1 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.

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

4.2.2.1 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.

TABLE I. Group A Inspection.

Inspection	Requirement Paragraph	Requirement Paragraph	Sampling Procedure
Subgroup 1			
Protective coating	3.4	4.4.3.2	
and surface treatment	3.5	4.4.1	As specified
Dimensions	3.7	4.4.1	per ASTM F1470
Surface roughness			
Subgroup 2 Cracks	3.9	4.4.3.3	

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

Downloaded from http://www.everyspec.com

4.2.3 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

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

4.3 Inspection of packaging. The sampling and inspection of the preservation, packing and container marking shall be in accordance with requirements of 5.1.

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 4.2.3.1 (GROUP B) shall be tested for surface hardness in accordance with NASM1312-6 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 4.2.2.1 (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 4.2.2.1 shall be subjected to magnetic particle inspection in accordance with ASTM E1444/E1444M. 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-STD-1907. There shall be no evidence of cracks or pits as specified in 3.9.

4.4.3.4 Decarburization. Samples taken as specified in 4.2.3.1 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 4.2.3.1, 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.

Downloaded from http://www.everyspec.com

4.4.3.5.2 Curved spring washers. Curved spring washer samples, taken as specified in 4.2.3.1, 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 4.2.3.1, shall be deflected one time to flat, to determine compliance with 3.10.1.2.

4.4.3.6.2 Wave spring washers. Wave spring washers taken as specified in 4.2.3.1, 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 4.2.3.1, 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 washer samples, taken as specified in 4.2.3.1, shall be deflected 10 times from free height to within .003 to .005 inch of solid height to determine conformance 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 washers samples, taken as specified in 4.2.3.1, shall be deflected 20 times from free height to determine conformance with 3.10.3.3.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Intended use of 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.

Downloaded from http://www.everyspec.com

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification and the applicable specification sheet.
b. Applicable specification sheet part number (see 3.4).
d. Protective finish required (see 3.7).
e. Packaging requirements (see 5.1).

6.3 Subject term (key word) listing.

Belleville
Cadmium plating
Corrosion
Curved
Wave

6.4 Cadmium is not recommended. To the users of this document, it is recommended that cadmium plating be used only when other materials and finishes specified in this document cannot meet performance requirements.

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodian:
Army - AR
Navy - OS
Air Force - 99
DLA - IS

Review Activity:
Army - AT, AV, CR4, MI
Navy - AS, MC, YD
Air Force - 71

Preparing Activity:

DLA - IS

(Project 5310-2015-005)

NOTE: The activities listed above were interested in this document as of the date of document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil.