

MIL-W-45595D  
16 AUGUST 1985  
SUPERSEDING  
MIL-W-45595C  
26 JUNE 1970

## MILITARY SPECIFICATION

### WASHERS, SHOULDERED, RECESSED, SADDLE, CONCAVE AND CONVEX 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; Shouldered, Recessed, Saddle, Concave and Convex.

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents

2.1.1 Specifications and standards. The following specifications and standards, form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

#### SPECIFICATIONS

##### FEDERAL

- QQ-A-250/5 - Aluminum Alloy Alclad 2024, Plate and Sheet
- QQ-A-250/12 - Aluminum Alloy 7075, Plate and Sheet
- QQ-P-416 - Plating, Cadmium (Electrodeposited)
- L-P-410 - Plastic, Polyamide (Nylon), Rigid: Rods, Tubes, Flats, Molded and Cast Parts.
- PP-H-1581 - Hardware (Fasteners and Related Items), Packaging of

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Armament, Munitions and Chemical Command, ATTN: AMSMC-TDA-S(D), Dover, New Jersey 07801-5001, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 5310

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## MILITARY

- MIL-C-5541 - Chemical Conversion Coatings on Alluminum Alloys
- MIL-S-6049 - Steel, Chrome-Nickel-Molybdenum (8740) Bars and Reforging Stock (Aircraft Quality).
- MIL-S-6758 - Steel, Chrome-Molybdenum (4130) Bars and Reforging Stock (Aircraft Quality).
- MIL-I-6868 - Inspection Process, Magnetic Particle.
- MIL-A-8625 - Anodic Coatings, for Aluminum and Aluminum Alloys
- MIL-P-14078 Polytetrafluoroethylene (Teflon), Molded and Extruded Parts, Sheets, Rods, and Tubing.
- MIL-S-18729 Steel Plate, Sheet, and Strip, Alloy 4130 Aircraft Quality.

(See supplement 1 for list of associated specification sheets)

## STANDARDS

## MILITARY

- MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes.

- MIL-STD-1312 Fasteners, Test Methods.

(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. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

## ASTM

- ASTM A109 - Steel, Carbon, Cold-Rolled Strip.
- ASTM D4066 - Nylon Injection and Extrusion Materials (PA) Standard Specification for

(Applications for copies should be addressed to ASTM, 1916 Race Street, Philadelphia, PA 19103).

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI B46.1 - Surface Texture (Surface Roughness, Waviness and Lay)

(Applications for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018).

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SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

AMS 3651 - Polytetrafluoroethylene.

(Application for copies should be addressed to the Society of Automotive Engineers, Inc. Warrendale, PA 15096).

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services).

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated specification sheets), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede 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 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 shall be used to the maximum extent practicable.

3.2.1 Polyamide (NYLON). Polyamide, shall be in accordance with ASTM D4066 or L-P-410, Polyhexamethylene adipamide, (Nylon 6/6).

3.2.2 Polytetrafluoroethylene. Polytetrafluoroethylene, shall be in accordance with AMS 3651 or MIL-P-14078.

3.2.3 Aluminum Alloy. Aluminum alloy, shall be in accordance with QQ-A-250/5, 2024-T4 or QQ-A-250/12, 7075-T6.

3.2.4 Alloy steel. Alloy steel, shall be Grade 4130 (UNS G41300) in accordance with MIL-S-6758 and MIL-S-18729, or Grade 8740 (UNS G87400) in accordance with MIL-S-6049.

3.2.5 Carbon steel. Carbon, steel, shall be Grades 1008 thru 1018 in accordance with ASTM A109.

3.3 Surface hardness. Alloy steel, concave and convex washers shall have a surface hardness of 40-46HRC.

3.4 Protective finish or surface treatment. The protective finish or surface treatment of the washers when specified in the applicable specification sheet shall be as follows.

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3.4.1 Cadmium plate. Carbon and alloy steel washers shall be cadmium plated in accordance with QQ-P-416, Type II, Class 3.

3.4.2 Anodic coating. Aluminum alloy washers shall be anodized in accordance with MIL-A-8625, Type I or Type II, Class 1.

3.4.3 Chemical surface treatment. Aluminum alloy washers shall be subjected to the chemical surface treatment in accordance with MIL-C-5541, Class 1A.

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

3.6 Surface roughness. Prior to coating, alloy steel washers shall have a maximum surface roughness of 32 microinches; Aluminum alloy and carbon steel washers shall be 125 microinches, measured in accordance with ANSI B46.1.

3.7 Edges and burrs. All edges shall be broken and free from burrs.

3.8 Cracks. All washers shall be free from cracks, flaws and pits in any location.

3.9 Workmanship. All 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 prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

#### 4.2 Quality conformance inspection.

4.2.1 Inspection of product for delivery. Inspection of product for delivery shall consist of Group A and B inspections.

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

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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 MIL-STD-105, Inspection level S-3. Major and minor defects shall be as defined in Table II. Sampling and inspection for Subgroup 2 shall be in accordance with MIL-STD-105, Inspection level S-1.

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 removes 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 tightened inspection procedure of MIL-STD-105.

4.2.1.2.1.2. Rejected lots (Subgroup 2). If an inspection lot is rejected, the manufacturer may screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection procedure of MIL-STD-105. Such lots shall be separate from new lots and shall be clearly identified as reinspected lots.

TABLE I. GROUP A INSPECTION.

INSPECTION	REQUIREMENT PARAGRAPH	TEST METHOD PARAGRAPH
<u>Subgroup 1</u>		
Protective finish or surface treatment	3.4	4.4.3.2
Dimensions	3.5	4.4.1
Surface roughness	3.6	4.4.1
<u>Subgroup 2</u>		
Cracks	3.8	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.

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TABLE II. CLASSIFICATION OF DEFECTS.

CATEGORY	DEFECT	INSPECTION METHOD
Critical	None defined	
Major	AQL = 2.5 percent defective	
101	Inside diameter, (see 3.5)	CIE <sup>1/</sup>
102	Outside diameter, (see 3.5)	CIE <sup>1/</sup>
103	Thickness, (see 3.5)	CIE <sup>1/</sup>
104	Shoulder height, (see 3.5)	CIE <sup>1/</sup>
105	Shoulder diameter, (see 3.5)	CIE <sup>1/</sup>
106	Radius (sphericity), (see 3.5)	CIE <sup>1/</sup>
107	Radius (curvature), (see 3.5)	CIE <sup>1/</sup>
108	Height, (see 3.5)	CIE <sup>1/</sup>
109	Length, (see 3.5)	CIE <sup>1/</sup>
110	Width, (see 3.5)	CIE <sup>1/</sup>
111	Cracks or pits, (see 3.8)	Visual
Minor	AQL = 4.0 percent defective	
201	Dimensions, other than above, (see 3.5)	CIE <sup>1/</sup>
202	Protective finish or surface treatment missing or incomplete, (see 3.4)	Visual
203	Surface roughness, (see 3.6)	CIE <sup>1/</sup>
204	Workmanship, (see 3.9)	Visual

<sup>1/</sup>Commercial Inspection Equipment

4.2.1.3 Group B inspection. Group B inspection shall consist of the test specified in Table III.

TABLE III. GROUP B INSPECTION.

INSPECTION	REQUIREMENT PARAGRAPH	TEST METHOD PARAGRAPH	AQL (PERCENT DEFECTIVE)
Surface hardness	3.3	4.4.3.1	1.5

4.2.1.3.1 Sampling plan. The sampling plan shall be in accordance with MIL-STD-105. Unless otherwise specified, S-1 inspection shall be used.

4.2.1.3.2 Defectives. If the number of defects exceed the number allowed in Table II, the sample shall be considered to have failed.

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4.2.1.3.3 Disposition of samples. Sample units which have been subjected 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 Group B inspection, 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 requirements of PPP-H-1581.

#### 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, 3.6, 3.9 and 4.2.1.2.

4.4.2 Material inspection. Material inspection shall consist of certification supporting verifying data that the materials used in fabricating the washers are in accordance with the applicable requirements of 3.2.

#### 4.4.3 Surface hardness and finish inspection.

4.4.3.1 Surface hardness inspection. Samples taken as specified in 4.2.1.3 shall be tested for surface hardness in accordance with MIL-STD-1312, Test Method 6 and 3.3.

4.4.3.2 Protective finish or surface treatment inspection. Samples taken as specified in 4.2.1.2 shall be inspected for adequacy of plating in accordance with applicable specification of 3.4.

4.4.3.3 Magnetic particle (cracks) inspection. Samples taken as specified in 4.2.1.2 shall be subjected to magnetic particle inspection in accordance with MIL-I-6868. There shall be no evidence of cracks or pits as specified in 3.8.

### 5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with PPP-H-1581 (see 6.2).



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## 6. NOTES

6.1 Intended use. The washers covered by this specification are intended for automotive, aircraft, and general bolt, nut and screw applications. Their purpose is to provide a bearing surface to prevent galling of the base material.

6.2 Ordering data.

6.2.1 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 numbers (see 3.1).
- c. Level (degree) of protection in accordance with PPP-H-1581, ordering data (see 5.1).

6.3 Changes from previous issue. Asterisks (or vertical lines) are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

## Custodians:

Army - AR  
Air Force - 99

## Preparing activity:

Army - AR

## Review activities:

Army - AV, ER  
Air Force - 11, 82  
DLA - IS

(Project 5310-1341)

## User activities:

Navy - EC  
NSA - NS

## Agent:

DLA - IS



**INSTRUCTIONS:** In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

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

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**STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL***(See Instructions – Reverse Side)***1. DOCUMENT NUMBER**

MIL-W-45595D

**2. DOCUMENT TITLE**

WASHERS Project Nos: 5310-1341 thru 5310-1348

**3a. NAME OF SUBMITTING ORGANIZATION****4. TYPE OF ORGANIZATION (Mark one)**☐

VENDOR

☐

USER

☐

MANUFACTURER

☐

OTHER (Specify) \_\_\_\_\_

**b. ADDRESS (Street, City, State, ZIP Code)****5. PROBLEM AREAS****a. Paragraph Number and Wording.****b. Recommended Wording.****c. Reason/Rationale for Recommendation****6. REMARKS****7a. NAME OF SUBMITTER (Last, First, MI) – Optional****b. WORK TELEPHONE NUMBER (Include Area Code) – Optional****c. MAILING ADDRESS (Street, City, State, ZIP Code) – Optional****8. DATE OF SUBMISSION (YYMMDD)**

MIL-W-45595D  
SUPPLEMENT 1  
16 AUGUST 1985

MILITARY SPECIFICATION

WASHERS, SHOULDERED, RECESSED, SADDLE,  
CONCAVE AND CONVEX

GENERAL SPECIFICATION FOR

This supplement forms a part of Military Specification MIL-W-45595D, dated 16 August 1985, and is approved for use by all Departments and Agencies of the Department of Defense.

SPECIFICATION SHEETS

- MIL-W-45595/1 - Washer, Shouldered, Polyamide (Nylon)
- MIL-W-45595/2 - Washer, Shouldered, Polytetrafluoroethylene
- MIL-W-45595/3 - Washer, Recessed, Aluminum Alloy
- MIL-W-45595/4 - Washer, Saddle, Steel, Carbon
- MIL-W-45595/5 - Washer, Saddle, Aluminum Alloy
- MIL-W-45595/6 - Washer Concave, Steel, Alloy
- MIL-W-45595/7 - Washer, Convex, Steel, Alloy

Preparing Activity  
Army-AR