

MIL-W-5521B
 13 December 1968
 SUPERSEDING
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MILITARY SPECIFICATION

WASHER, AIRCRAFT HYDRAULIC PACKING BACK-UP

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

1. SCOPE

- * 1.1 This specification establishes the requirements for one type of packing back-up washers for use in aircraft hydraulic systems.

2. APPLICABLE DOCUMENTS

- * 2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

Federal

KK-L-311	Leather; Methods Of Sampling And Testing
QQ-A-250/4	Aluminum Alloy 2024, Plate And Sheet
QQ-B-626	Brass, Leaded And Nonleaded: Rod, Shaped, Forgings, And Flat Products With Finished Edges (Bar And Strip)
QQ-B-750	Bronze, Phosphor; Bar, Plate, Rod, Sheet, Strip, Flat Wire And Structural And Special Shaped Sections
PPP-B-566	Boxes, Folding, Paperboard
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-621	Boxes, Wood, Nailed And Lock-Corner
PPP-B-636	Box, Fiberboard
PPP-B-676	Boxes, Setup

Military

MIL-P-116	Preservation, Methods Of
MIL-P-5514	Packings; Installation And Gland Design, Hydraulic, General Requirements For
MIL-P-5516	Packing, Preformed, Petroleum Hydraulic Fluid Resistant, 160°F
MIL-H-5606	Hydraulic Fluid, Petroleum Base; Aircraft, Missile, And Ordnance

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MIL-H-6083	Hydraulic Fluid, Petroleum Base, For Preservation And Testing
MIL-S-7720	Steel, Corrosion-Resistant (18-8) Bars, And Forging Stock (For Aircraft Applications)
MIL-S-18729	Steel Plate, Sheet And Strip, Alloy 4130, Aircraft Quality

STANDARDS

Federal

FED-STD-791	Lubricants, Liquid Fuels, And Related Products; Methods Of Testing
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Military

MIL-STD-105	Sampling Procedures And Tables For Inspection By Attributes
MIL-STD-129	Marking For Shipment And Storage
MIL-STD-831	Test Reports, Preparation Of
MS28777	Ring, Hydraulic Fitting, Gasket Back-Up
MS35803	Retainer, Packing, Back-Up Ring, Leather

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

3. REQUIREMENTS

- * 3.1 Qualification. The washers furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.3).
- * 3.2 Material. The leather from which back-up washers are manufactured, shall be made from cattle hides. The finished washers shall be unimpregnated, free from soft, spongy, harsh, or raw spots and shall be free from defects. Unimpregnated leather is defined as leather which contains no additives other than the normal tanning agents and greases. The greases normally used during the tanning process to lubricate the fibers shall not be considered an impregnant. However, any material added to the leather after the normal tanning process as defined above, for the purpose of stiffening or filling the leather, shall be considered an impregnant.
 - * 3.2.1 Finish. The leather shall be full grain, with the flesh side smooth and free from loose flesh.
 - * 3.2.2 Compatibility with fluid. The leather back-up washers shall not adversely affect or be adversely affected by hydraulic fluid conforming to MIL-H-5606.

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- * 3.3 Tannage. The leather shall be tanned with chromium salts (mineral-tanned) without the use of vegetable tanning materials (see Table I). Processes employed shall be such as to produce satisfactory leather which will meet all requirements specified herein without the use of impregnants as defined under 3.2. The grease content specified herein shall be attained during the normal tanning process. No degreasing shall be employed after the normal tanning process.
- * 3.4 Form. The leather shall be in the form of special trimmed butt bends or special backs.
 - * 3.4.1 Trim of special butt bend. The butt bend will be considered a hide with the shoulder cut off at right angle to the belly edge at the break in the fore-shank. The belly and belly slabs will be removed leaving a 36-inch center (18 inches either side of the back bone) (see Figure 1b).
 - * 3.4.2 Trim of special backs. A back will be considered half a hide, cut along the back bone line with the head, neck and any portion of the wrinkled shoulder cut off. The belly and belly slab will be removed leaving a strip not over 18 inches wide when measured perpendicular to the back bone line (see Figure 1a).
- * 3.5 Physical properties. The leather shall be subjected to tests in Section 4 and conform to requirements as follows:
 - a. Thickness. Leather shall be selected for thickness with a minimum of splitting or skiving (see 4.6.2).
 - b. Cracking resistance. A test specimen shall not crack open when subjected to cracking resistance test (see 4.6.3).
 - c. Tensile strength. The tensile strength of four test specimens shall be a minimum of 2500 pounds per square inch (psi) with an average of not less than 3000 psi before splitting (see 4.6.4).
 - d. Elongation. Each of four test specimens shall have a minimum elongation of 24 percent and a maximum elongation of 36 percent before splitting (see 4.6.5).
- * 3.6 Chemical composition. The leather upon analysis shall conform to the chemical composition given in Table I when tested in accordance with paragraphs in Section 4 headed as follows:
 - a. Grease (see 4.6.6)
 - b. Chlorides (see 4.6.7)
 - c. Sulfates (see 4.6.8)
 - d. Ash (see 4.6.9)
 - e. Chromic oxide (see 4.6.10)

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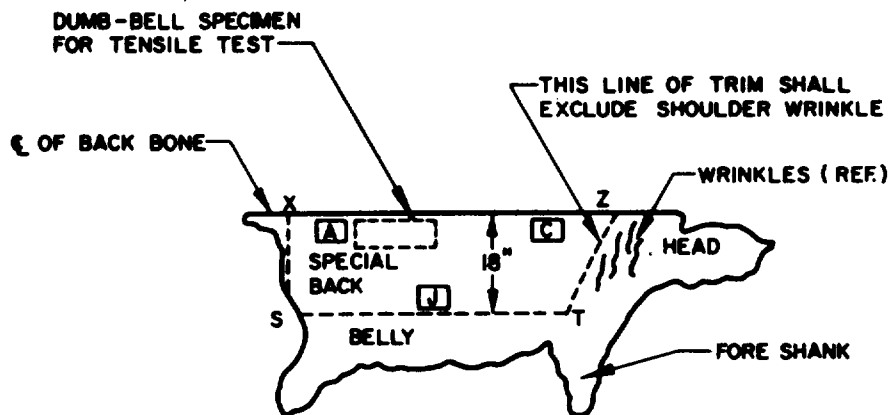


FIGURE 1a. 1/2 Hide—Showing Trim of Special Back

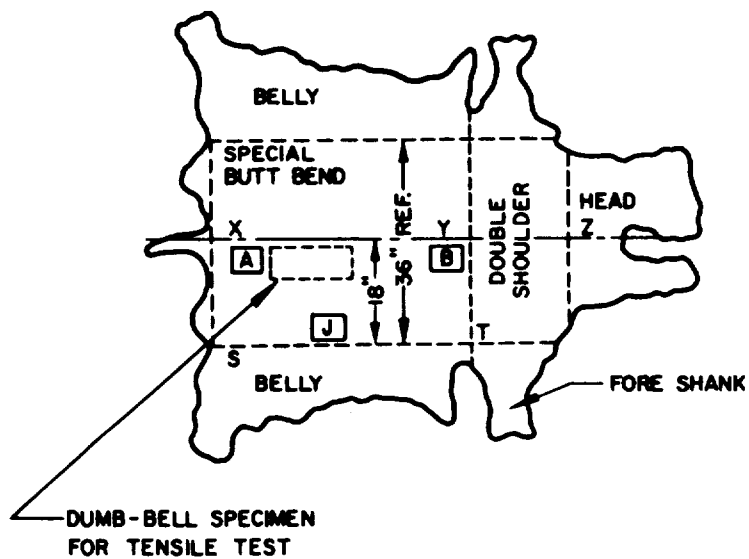


FIGURE 1b. Hide—Showing Trim of Special Butt Bend

TABLE I
CHEMICAL COMPOSITION

Component	Percent (by Weight)	
	Minimum	Maximum
Grease <u>1/</u>	3	8.0
Chlorides as NaCl <u>2/</u>	--	.30
Sulfates as H ₂ SO ₄ <u>2/</u>	--	.30
Ash <u>2/</u>	Shall be not more than 130 percent of the chromic oxide	
Chromic oxide <u>2/</u>	3.5	--

1/ Moisture-free basis.

2/ Moisture-free and grease-free basis.

- * **3.7 Performance.** The hydraulic back-up washers (the finished product) shall be subjected to tests in Section 4 and shall conform to the requirements below:
- a. **Low temperature flexibility.** There shall be no appreciable difference in the flexibility of the washers at -54° Centigrade (C) (-65° Fahrenheit (F)) and the flexibility of the washers at room temperature (see 4.6.11).
- b. **Firmness.** After being subjected to the firmness test, the washer cross section shall have maintained a rectangular shape with the corners true and sharp, and shall show no evidence of flabbiness, peeling, disintegration, or malfunctioning (see 4.6.12).
- c. **Endurance.** The Services reserve the right, when deemed necessary, to subject finished back-up washers to endurance tests. Finished back-up washers, when installed in glands in accordance with MIL-P-5514, shall be subjected to the applicable performance tests outlined in MIL-P-5516 except that the operating pressure shall be 3000 psi (see 4.6.13).
- d. **Corrosion and adhesion.** There shall be no corrosion and adhesion detected in the corrosion and adhesion tests (see 4.6.14).
- * **3.8 Dimensions.** Finished hydraulic back-up washers shall conform to MS35803 or MS28777, as applicable.
- * **3.9 Identification of product.**
- * **3.9.1 Use of AN, MS or MIL designations.** AN, MS or MIL designations shall not be applied to a product, except for qualification test samples, in correspondence or sales matter until notification has been received from the Qualifying

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Activity that the product has been approved for listing in the applicable Qualified Products List.

- * 3.9.2 Identification of product. All hydraulic packing back-up washers shall be identified by a dye applied to the hair side of the hide. The color of the dye shall be specified, upon qualification, by the Qualifying Activity.
- * 3.10 Workmanship. All details of workmanship shall be in accordance with high grade commercial practice.

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 inspections are deemed necessary to assure supplies and services conform to prescribed requirements.
- * 4.2 Sampling, inspection and test procedures.
 - * 4.2.1 Classification of tests. The inspection and testing of hydraulic packing back-up washers shall be classified as follows:
 - a. Qualification tests. Qualification tests are those tests accomplished on samples submitted for qualification as a satisfactory product.
 - b. Quality conformance inspection. Quality conformance inspection consists of those tests accomplished on the finished products and the leather submitted for acceptance under contract.
- * 4.3 Qualification tests.
 - * 4.3.1 Sampling instructions. Samples for qualification tests shall consist of the following:
 - a. One special butt bend.
 - b. One special back.
 - c. Sixteen MS35803-214 washers.
 - d. Eight MS35803-218 washers.
 - e. Nine MS35803-325 washers.

(NOTE: The location and direction of the backbone line shall be clearly marked on the special butt bend and special back samples when submitted for qualification tests.)

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- * 4.3.2 Test report. Contractor shall furnish test reports in accordance with MIL-STD-831, the requirements below, and any other requirement specified by the Qualifying Activity.
- a. Manufacturer's identification number (or part number) of the leather.
 - b. General method of stock preparation and size of hides from which the qualification samples were produced.
 - c. Detailed report of manufacturer's proposed method of controlling the quality of the finished product for which approval is requested in accordance with requirements specified herein.
 - d. Except for performance tests, all tests specified herein shall be accounted for in report form.
 - e. Name of tannery. (If leather is obtained from more than one tannery, the names and samples of each must be submitted.)
- * 4.4 Tests. Qualification tests shall consist of all the tests specified in 4.6.
- * 4.5 Quality conformance inspection. Quality conformance inspection shall consist of the following tests:
- a. Individual test.
 - b. Quality control test.
- * 4.5.1 Individual test. Each article submitted for acceptance under contract shall be subjected to the following tests, as described under 4.6:
- a. Examination of product.
 - b. Firmness.
- * 4.5.2 Quality control tests. Quality control tests shall consist of all tests specified under 4.5.2.2.
- * 4.5.2.1 Sampling instructions. The number of special butt bends and special backs to be sampled during production of hydraulic packing back-up washers which are to be furnished under contract shall be as follows:

<u>No. of Butt Bends or Backs Required</u>	<u>No. to be Sampled</u>
up to 20	1
21 to 100	2
over 100	2 percent

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- * 4.5.2.1.1 Specimens for physical tests. Specimens for physical tests shall be taken from the special butt bend or special back before the ordered back-up washers are cut to the specified size. The specimen shall be cut 3 inches wide beginning 1 inch from the backbone edge and 16 inches long beginning 15 inches from the root of the tail and running toward the shoulder end.
- * 4.5.2.1.2 Specimens for chemical analysis. Specimen pieces for chemical analysis shall be taken from units as shown on Figures 1a and 1b and the following table:

<u>Unit</u>	<u>Pieces</u>
Special Back	A C J
Special Butt Bend	A B J

The pieces shall be approximately 2 inches by 4 inches and their relative location on the hide shall be as follows:

- a. Cut A with the bottom edge 10 inches from the root of the tail and the top edge 1 inch from the line XZ.
- b. Cut B with front edge 4 inches from front edge of special butt bend and top edge 1 inch from line XY.
- c. Cut C with rear edge at a distance from the root of the tail equal to three-fourths of XZ and the top edge 1 inch from the line XZ.
- d. Cut J equidistant from ends and with bottom edge 1 inch from line ST.

A portion of the leather shall be cut from each piece, the portions being approximately equal in weight. The portions shall be ground in a Wiley mill so that all will pass through a 4 millimeter (mm) screen. The composite specimen shall be thoroughly mixed and stored in a tightly stoppered bottle for chemical tests outlined herein.

- * 4.5.2.1.3 Specimens shall be in addition to the quantity specified in the contract or purchase order and shall be furnished without additional cost to the Government.
- * 4.5.2.2 Tests. Quality control tests of material shall consist of the following tests, as described under 4.6.
 - a. Tensile strength (see 4.6.4)
 - b. Elongation (see 4.6.5)
 - c. Grease (see 4.6.6)
 - d. Chlorides (see 4.6.7)

- e. Sulfates (see 4.6.8)
- f. Ash (see 4.6.9)
- g. Chromic oxide (see 4.6.10)

* 4.5.3 Rejection and retests.

- * 4.5.3.1 Individual washers. If any hydraulic packing back-up washer fails to comply with any of the requirements of 4.5.1, it shall be rejected.
- * 4.5.3.2 Material specimens. Failure of any sample to comply with any one of the requirements of this specification shall require a retest of the lot from which the sample was selected. The number of special backs and special butt bends to be sampled for retest shall be twice the number listed in 4.5.2.1. If any of the retest samples fail to comply with any of the requirements set forth herein, the lot of material from which the samples were selected shall be rejected. A lot of material is defined as any number of special backs and special butt bends delivered from the tannery to the fabricator as a single shipment.

* 4.6 Test methods.

* 4.6.1 Examination of product.

- * 4.6.1.1 Each individual washer shall be carefully examined to determine compliance to the applicable standards for acceptable workmanship, finish, and trim.
- * 4.6.1.2 Washers shall be inspected for outside diameter, inside diameter, width, thickness, and cross sectional corner angles where applicable. All dimensions shall conform to the applicable standard. Dimensional inspections shall be performed on a sample basis in accordance with MIL-STD-105, using a single sample plan, general inspection level I, with an AQL of 1.0 percent defective.
- * 4.6.2 Thickness. Leather shall be selected for thickness with a minimum of splitting or skiving. In no case shall leather 1/16 inch thick be obtained by splitting leather which was originally 1/8 inch thick.
- * 4.6.3 Cracking resistance. The cracking resistance test shall be in accordance with Method 4011 of KK-L-311. The diameter of the mandrel shall be 1/2 inch. The test specimen in accordance with 4.5.2.1.1 shall be initially heated to 71°C (160°F) and maintained at that temperature at all times throughout the test. The test specimen shall remain in the clamped, bent position at 71°C for seven days, and it shall not crack open on the grain side in the area around the bend.
- * 4.6.4 Tensile strength. The tensile strength test shall be in accordance with Method 2021.1 of KK-L-311. Four test specimens in accordance with 4.5.2.1.1 shall be cut from the sample for this test. The tensile strength for any one

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test specimen shall be a minimum of 2500 psi with an average of not less than 3000 psi before splitting. The tensile strength for each of the four test specimens shall be recorded in addition to the average value.

- * 4.6.5 Elongation. The elongation test shall be in accordance with Method 2021.1 of KK-L-311. The elongation shall be determined on the same four specimens used for the tensile strength tests and shall be measured at a stress of 2500 psi. Each of the specimens shall have a minimum elongation of 24 percent and a maximum elongation of 36 percent before splitting.
- * 4.6.6 Grease. The grease test shall be in accordance with Method 6311.1 of KK-L-311. Only one 4 gram test specimen, in accordance with 4.5.2.1.2, shall be tested and shall constitute the sample for this test.
- * 4.6.7 Chlorides. The chlorides test shall be in accordance with Method 6351 of KK-K-311. Only one 5 gram test specimen in accordance with 4.5.2.1.2 shall be tested and shall constitute the sample for this test.
- * 4.6.8 Sulfates. The sulfates test shall be in accordance with Method 6361 of KK-L-311. Only one 5 gram test specimen in accordance with 4.5.2.1.2 shall be tested and shall constitute the sample for this test.
- * 4.6.9 Ash. The ash test shall be in accordance with Method 6421 of KK-L-311. Only one 5 gram test specimen in accordance with 4.5.2.1.2 shall be tested and shall constitute the sample for this test.
- * 4.6.10 Chromic oxide. The chromic oxide test shall be in accordance with Method 6515 of KK-L-311. Only one 5 gram test specimen in accordance with 4.5.2.1.2 shall be tested and shall constitute the sample for this test.
- * 4.6.11 Low temperature flexibility. Six MS35803-325 washers shall be used for this test:
 - a. Two shall be aged in MIL-H-5606 fluid for seven days at $70^{\circ} \pm 1^{\circ}\text{C}$ ($158^{\circ} \pm 2^{\circ}\text{F}$).
 - b. Two shall be aged in air for seven days at the same temperature.
 - c. The remaining two shall be kept unaged.

One washer each of a, b and c shall be subjected to a temperature of -54°C (-65°F) for not less than 96 hours, and one each of a, b and c shall be kept at room temperature for the same period of time. After the cold soak period, there shall be no appreciable difference in the flexibility of the washers at -54°C (-65°F) and the washers kept at room temperature.

- * 4.6.12 Firmness. Each individual MS35803 and MS28777 back-up washer during inspection shall be grasped between the thumb and forefinger as indicated in Figure 2 and rolled one complete revolution of the cross section under normal hand pressure by a sliding motion of the forefinger relative to the thumb. When returned to a flat condition after this twisting, the washer cross section

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shall have maintained a rectangular shape with the corners true and sharp, and shall show no evidence of flabbiness, peeling, disintegration or malfunctioning. There shall be no whiskers on the washer as defined in Figure 2.

- * 4.6.13 Endurance tests. Finished back-up washers when installed in glands in accordance with MIL-P-5514 shall be subjected to the applicable performance tests outlined in MIL-P-5516 except that the operating pressure shall be 3000 psi.
- * 4.6.14 Corrosion and adhesion test. Ten MS35803-214 hydraulic packing back-up washers or leather specimens of approximately equivalent size shall be prepared for corrosion testing by inserting specimens in a desiccator or similar humidity chamber maintained at 95 percent minimum relative humidity and at room temperature for 72 hours minimum. Metallic plates of the metals listed below shall be polished to a surface roughness of 8 to 16 microinch root mean square (rms) finish. The edges shall also be polished to reduce the formation of edge corrosion. Plates shall be washed with precipitation naphtha as specified in FED-STD-791 or similar degreasing agent. The metals used shall be as follows:
 - a. Aluminum-alloy (QQ-A-250/4)
 - b. Brass (QQ-B-626)
 - c. Bronze (QQ-B-750)
 - d. Steel (MIL-S-18729)
 - e. Stainless steel (MIL-S-7720, Condition A)

The humidified back-up washers and the metallic plates shall be immersed in MIL-H-6083 rust preventative fluid (MIL-H-5606 fluid base), and drained to the drip point. The washer and plates shall then be laid together in a stack so that at least two back-up washers contact each specified metal. The stack shall be held together with a pressure of 20 to 30 pounds and placed in a desiccator which is held at 90 to 95 percent relative humidity at room temperature. A separate set of metallic plates shall also be prepared (buffing, cleaning and dipping in the same rust preventative fluid and drained) and placed in the desiccator in such a manner that the control plates do not touch each other or any of the back-up washers. ((Di-potassium acid phosphate when placed in distilled water in sufficient quantity to produce a saturated solution, will maintain approximately 92 percent humidity in a sealed desiccator at 20°C (68°F) temperature.)) Time of immersion for this portion of test shall be 96 hours minimum for all inspection tests and 14 days minimum for all qualification test analyses. No more than 15 minutes should elapse between the time the test samples are removed from the pre-humidifying chamber and placed in the stacked condition in the second humidity chamber. At the termination of this test, there shall be no adhesion of the leather to the metals nor shall there be any evidence of pitting, erosion, corrosion or bad discoloration, as determined by the following procedure: Inspect the surfaces of the plates which were in contact with the back-up washers for discoloration, deposits, pitting, et cetera. If any exist, the surfaces of the plates shall be washed in

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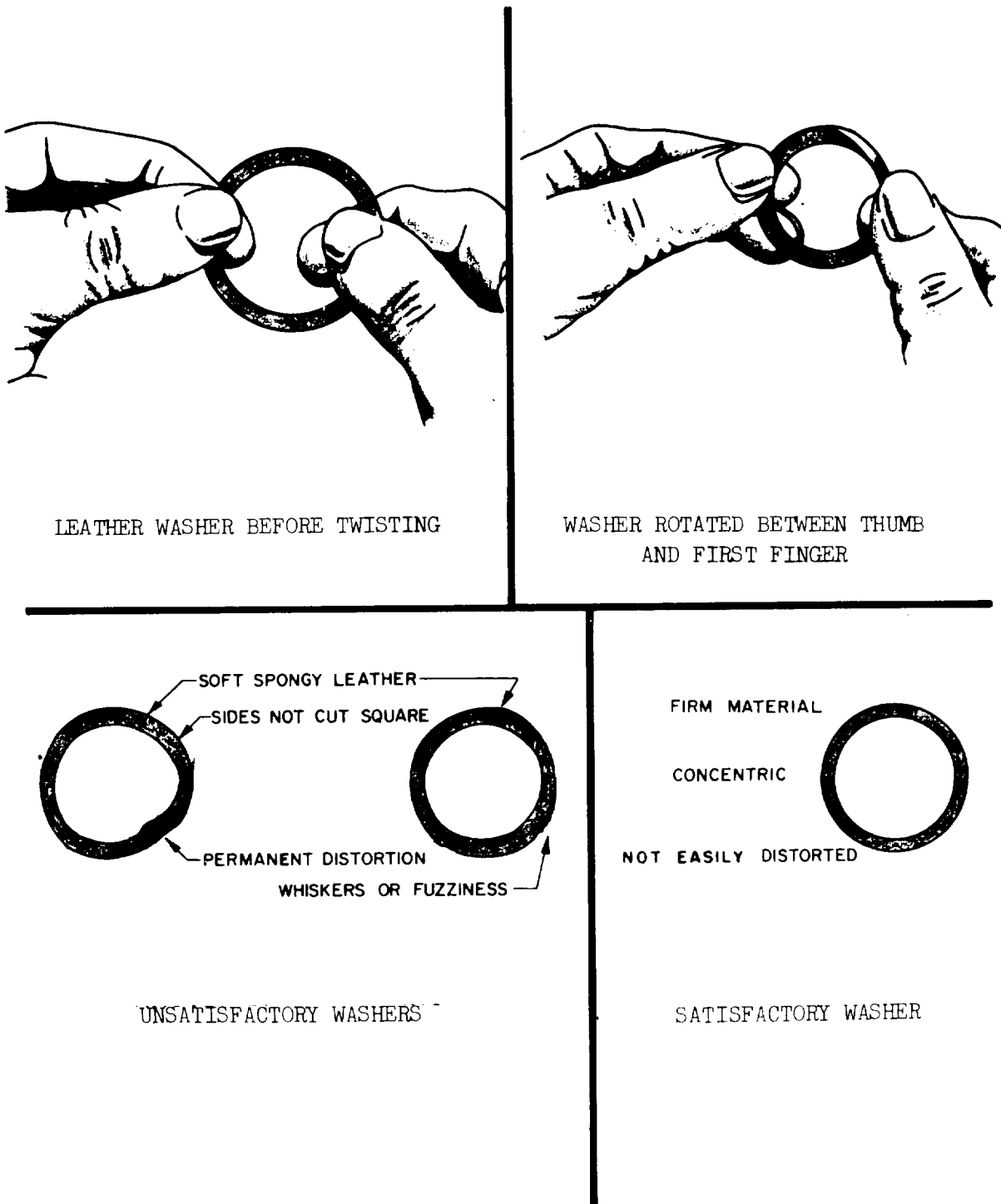


FIGURE 2
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precipitation naphtha. Deposits determined as leather which can be removed by this process and which do not occur on the separate control plates shall be construed as adhesion. If any other marks remain on the surfaces of the plates after inspection, the surfaces shall be lightly polished with a nonabrasive cloth buff. Any pits or eroded marks remaining after this process shall be construed to be corrosion. Discoloration or staining (marks which do not physically affect the surfaces of the plates and which easily wash or buff off) shall not be considered detrimental.

- * 4.7 Examination of preparation for delivery. The packaging, packing and marking of packing material shall be examined to determine compliance with the requirements of Section 5 of this specification. Examination of packaging requirements not covered by referenced specifications shall be performed in accordance with the examination requirements of MIL-P-116.
5. PREPARATION FOR DELIVERY
- * 5.1 Preservation and packaging. Preservation and packaging shall be level A or C as specified (see 6.2).
 - * 5.1.1 Level A. Back-up washers shall be packaged Method IC-1 of MIL-P-116, without the use of preservative compounds. The quantity per unit package shall be as specified by the procuring activity. The back-up washers shall be packaged in a manner that will insure washers will not become deformed. Unit packages shall be packaged in intermediate containers conforming to PPP-B-566 or PPP-B-676, Variety 2 - Water Resistant. The weight of the intermediate package shall not exceed 10 pounds.
 - * 5.1.2 Level C. Back-up washers shall be packaged in a manner which affords adequate protection against deterioration and physical damage during shipment from the supply source to the first receiving activity for immediate use. This level may conform to the supplier's commercial practice provided the latter meets the requirements of this level.
 - * 5.2 Packing. Packing shall be level A, B or C as specified (see 6.2).
 - * 5.2.1 Level A. Back-up washers packaged as specified in 5.1.1 shall be packed in fiberboard containers conforming to PPP-B-636, class weather resistant; wood, cleated-plywood containers conforming to PPP-B-601 overseas type, or wood nailed and lock corner, class 2 containers conforming to PPP-B-621. Containers conforming to PPP-B-601 shall be surface treated in accordance with the requirements of the specification.
 - * 5.2.2 Level B. Material shall be packed for shipment in containers conforming to those specified in 5.2.1, except that the containers shall be of domestic grade, class, type or style, where applicable.
 - * 5.2.3 Level C. Back-up washers packaged as specified in 5.1.2 shall be packed in a manner which affords adequate protection against damage during direct shipment from the supply source to the first receiving activity for immediate

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use. This level shall conform to applicable carrier rules and regulations and may be the supplier's commercial practice, provided the latter meets the requirements of this level.

- * 5.3 Marking. In addition to any special marking required by the contract or order, unit packages, intermediate containers, and exterior shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

- * 6.1 Intended use. The hydraulic packing back-up washers covered by this specification are intended for use with hydraulic "O" rings operating at pressures up to 3000 psi at temperatures up to 71°C (160°F) in accordance with MIL-P-5514.
- * 6.2 Ordering data. Procurement documents should specify the following:
 - a. Title, number and date of this specification.
 - b. AN or MS part number.
 - c. Selection of applicable levels of preservation, packaging and packing (see 5.1 and 5.2).
- * 6.3 With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the San Antonio Air Materiel Area, Service Engineering Division, ATTN: SANE, Kelly AFB, Texas 78241, and information pertaining to qualification of products may be obtained from that activity.
- * 6.4 It is to be understood that hydraulic back-up washers shipped under contract shall be identical in every respect to the sample tested and found satisfactory, except for changes previously approved by the Government. Any unapproved changes from the qualification sample shall constitute cause for rejection.
- * 6.4.1 In cases where the leather is not tanned by the same manufacturer who produces the finished hydraulic back-up washer, the tannery (or tanneries) shall be considered as subcontractor to the back-up washer manufacturer. It shall be the responsibility of the back-up washer manufacturer to submit the required Qualification and Inspection test reports and maintain the necessary quality control procedure. Approval, when granted, will cover both the tannery (or tanneries) and the back-up washer manufacturer. A change of source of leather material after approval has been granted will require a retest and a new qualification approval.

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- * 6.5 Identification of changes. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Air Force - 82
Army - AV

Preparing Activity:
Air Force - 82

Review Activities:
Air Force - 82, 85
Army - AV, WC, ME

Project No. 5330-0338

User Activity:
Army - AT