INCH-POUND

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DETAIL SPECIFICATION

WASHER, AIRCRAFT HYDRAULIC PACKING BACK-UP

INACTIVE FOR NEW DESIGN AFTER 22 AUGUST 1994

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

1. SCOPE

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

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in section 3, 4, or 5 of this standard. This section does not include documents cited in other sections of this standard or recommend 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, 4, or 5 of this standard, 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.

FEDERAL STANDARDS

FED-STD-311	Leather, Methods of Sampling and Testing
FED-STD-791	Lubricants, Liquid Fuels, and Related Products, Methods of Testing

Comments, suggestions, or questions on this document should be addressed to Defense Supply Center Philadelphia (DSCP), ATTN: DSCP-NASA, 700 Robbins Avenue, Philadelphia, PA 19111-5096 or e-mail to dscpg&inspecomments@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-G -5514	Gland Design, Packings, Hydraulic, General Requirements for
MIL-PRF-5606	Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance
MIL-PRF-6083	Hydraulic Fluid, Petroleum Base, for Preservation and Operation
MIL-P-25732	Packing, Preformed, Petroleum Hydraulic Fluid Resistant, Limited Service at 275 Deg. F (135 Deg C)

DEPARTMENT OF DEFENSE STANDARDS

MS28777	Washer, Flat, Aircraft Hydraulic Backup
MS35803	Washer, Aircraft Hydraulic Packing Backup

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-831	Preparation of Test Reports

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

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM-B36/B36M	Plate, Brass, Sheet, Strip, and Rolled Bar
ASTM-B139/B139M	Rod, Phosphor Bronze, Bar, and Shapes

(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.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE-AMS-QQ-A-250/4	Aluminum Alloy 2024, Plate and Sheet
SAE-AMS-S-7720	Steel, Corrosion-Resistant (18-8) Bars, Wire and Forging Stock (Aircraft Quality)
SAE-AMS6350	Steel Sheet, Strip, and Plate 0.95 Cr-0.20 Mo (0.28-0.33C) (SAE 4130)

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

AMERICAN SOCIETY FOR QUALITY (ASQ)

ASQ Z1.4	Sampling Procedures and Tables for Inspection by Attributes

(Copies of this document are available from www.asq.org or the American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203)

2.4 Order of precedence. In the event of a conflict between the text of this document and the reference 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 MS sheets. The individual item requirements shall be as specified herein and in accordance with the applicable MS sheet. In the event of any conflict between the requirements of this specification and the MS sheet, the latter shall govern.

3.2 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.3.

3.3 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.

3.3.1 Finish. The leather shall be full grain, with the flesh side smooth and free from loose flesh.

3.3.2 Compatibility with fluid. The leather back-up washers shall not adversely affect or be adversely affected by hydraulic fluid conforming to MIL-PRF-5606.

3.4. 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 3.3. The grease content specified herein shall be attained during the normal tanning process. No degreasing shall be employed after the normal tanning process.

3.5 Form. The leather shall be in the form of special trimmed butt bends or special backs.

3.5.1 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 (91.4 centimeter (cm) center (18 inches (45.7 cm) either side of the back bone) (see Figure 1b).

3.5.2 Trim of the 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 (45.7 cm) wide when measured perpendicular to the back bone line (see Figure 1a).

3.6 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) (17.24 Megapascals (Mpa))with an average of not less than 3000 psi (20.68 Mpa) 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).

3.7 Chemical composition. The leather upon analysis shall conform to the chemical composition given in Table 1 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)

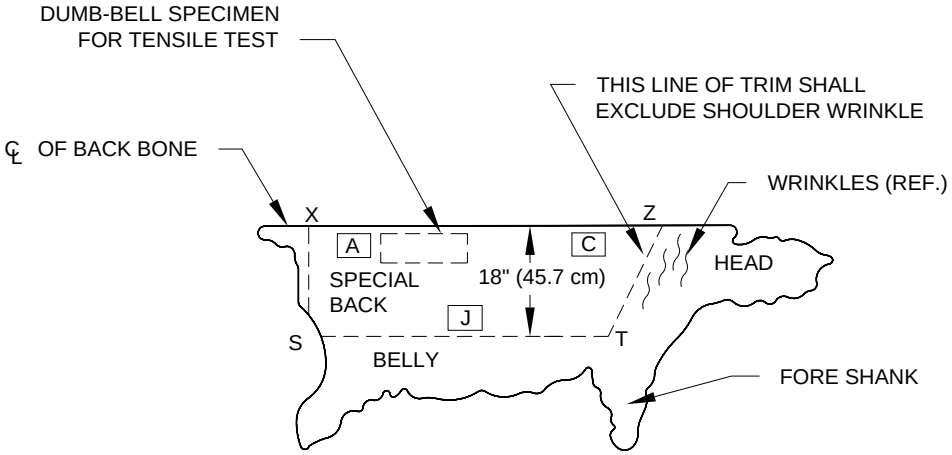

FIGURE 1a. 1/2 Hide-Showing Trim of Special Back

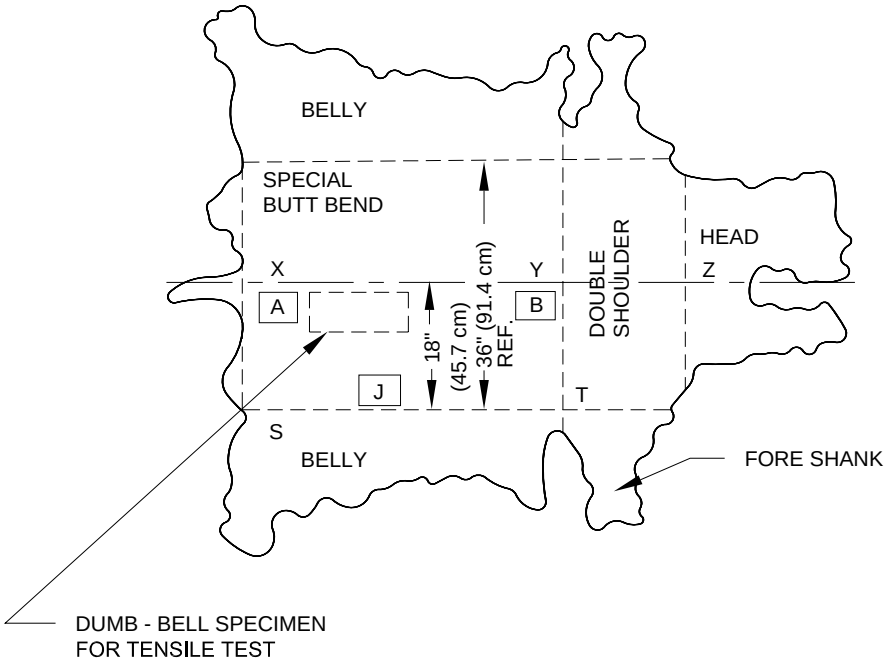

FIGURE 1b. Hide-Showing Trim of Special Butt Bend

TABLE I
CHEMICAL COMPOSITION

Component	Percent (by Weight)	
	Minimum	Maximum
Grease 1/	3	8.0
Chlorides as NaCl 2/	--	.03
Sulfates as H_2SO_4 2/	--	.03
Ash 2/	Shall be not more than 130 percent of the chromic oxide	
Chromic oxide 2/	3.5	--

1/ Moisture-free basis.
2/ Moisture-free and grease-free basis.

3.8 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 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-G-5514, shall be subjected to the applicable performance tests outlined in MIL-P-25732 except that the operating pressure shall be 3000 psi (20.68 Mpa) (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).

3.9 Dimensions. Finished hydraulic back-up washers shall conform to MS35803 or MS28777, as applicable.

3.10 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 by the procuring activity.

3.11 Workmanship. All details of workmanship shall be in accordance with high grade commercial practice.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.3).
b. Conformance inspection (see 4.5).

4.2 Inspection conditions. Unless otherwise specified (see 6.2) all inspections shall be performed in accordance with the applicable test conditions specified in MIL-STD-311.

4.3 First article inspection. First article inspection shall be performed at a laboratory acceptable to the procuring activity (see 6.3), on sample items produced with equipment and procedures normally used in production.

4.3.1 Sampling instructions. Samples for first article 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 sample when submitted for qualification tests.)

4.3.2 Test report. Contractor shall furnish test reports in accordance with MIL-HDBK-831, the requirements below, and any other requirement specified by the procuring 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. First article tests shall consist of all the tests specified in 4.6.

4.5 Conformance inspection. 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 submitted to the following tests, as described under 4.6:

a. Examination of reports.

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:

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

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 (7.62 cm) wide beginning 1 inch (2.54 cm) from the backbone edge and 16 inches (40.64) long beginning 15 inches (38.1 cm) from the root of the tail and running toward the shoulder end.

4.5.2.1.2 Specimens for chemical analysis. Specimens for chemical analysis shall be taken from units as shown on Figure 1a and 1b and the following table:

Unit	Pieces
Special Back	A C J
Special Butt Bend	A B J

The pieces shall be approximately 2 inches (5.08 cm) by 4 inches (10.16 cm) and their relative location on the hide shall be as follows:

a. Cut A with the bottom edge 10 inches (25.40 cm) from the root of the tail and the top edge 1 inch (2.54 cm) from the line XZ

b. Cut B with the front edge 4 inches (10.16 cm) from front edge of special butt bend and top edge 1 inch (2.54 cm) 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 (2.54 cm) from line XZ.

d. Cut J equidistant from ends and with bottom edge 1 inch (2.54 cm) 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 .16 inch (4 millimeter (mm)) screen. The composite specimen shall be thoroughly mixed and stored in a tightly stopped 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 fourth 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 preformed on a sample basis in accordance with ASQ Z1.4, using a single sample plan, general inspection level I, with a 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 .063 inch (1.59 mm) thick be obtained by splitting leather which was originally .125 inch (3.18 mm) thick.

4.6.3 Cracking resistance. The cracking resistance test shall be in accordance with Method 4011 of FED-STD-311. The diameter of the mandrel shall be .5 inch (12.7 mm). 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 of FED-STD-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 test specimen shall be a minimum of 2500 psi (17.24 Mpa) with an average of not less than 3000 psi (20.68 Mpa) 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 of FED-STD-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 (17.24 Mpa). 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 of FED-STD-311. Only one 4 gram test specimen, in accordance with 4.5.3.1.2, 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 FED-STD-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 Sulfate. The sulfates test shall be in accordance with Method 6361 of FED-STD-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 FED-STD-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 FED-STD-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 use for this test:

a. Two shall be aged in MIL-PRF-5606 fluid for seven days at 70° ±1°C (158° ±2°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 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-G-5514 shall be subjected to the applicable performance tests outlined in SAE-AMS-P-5516 except that the operation pressure shall be 3000 psi (20.68 Mpa).

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 microinches 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 (AMS-QQ-A-250/4)

b. Brass (ASTM-B36/B36M)

c. Bronze (ASTM-B139/B139M)

d. Steel (AMS 6350)

e. Stainless steel (AMS-S-7720, Condition A)

The humidified back-up washers and the metallic plates shall be immersed in MIL-PRF-6083 rust preventative fluid (MIL-PRF-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 precipitation naphtha. Deposits determined as leather which can be removed by this process and which do no 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.

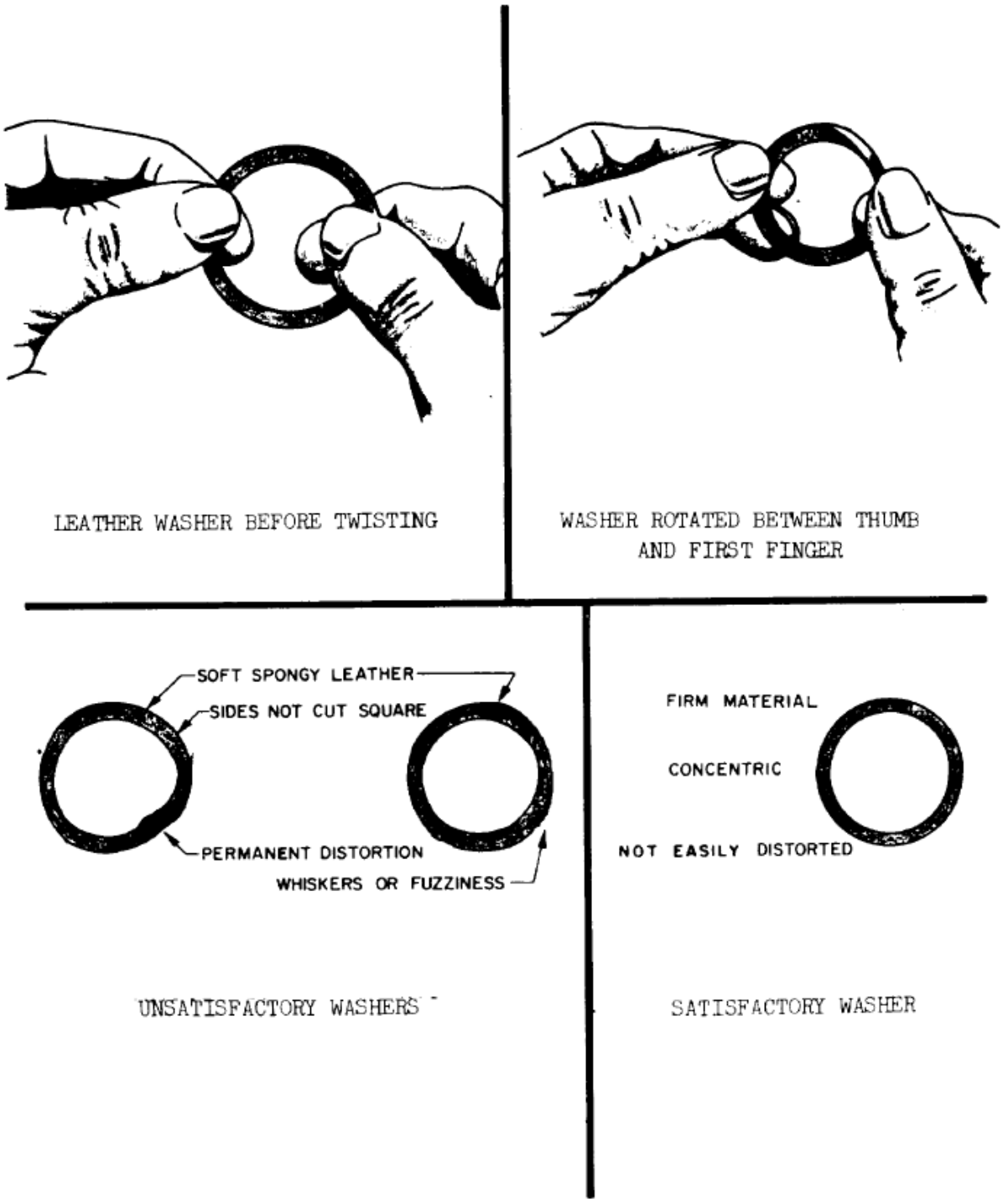

FIGURE 2

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 then 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. 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 (20.68 Mpa) at temperatures up to 71°C (160°F) in accordance with MIL-G-5514.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. MS part number (see applicable MS sheet).
c. If first article samples are required (see 3.2).
d. Packaging requirements (see 5.1).

6.3 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerers whether the first article (s) should be a preproduction sample, an initial production sample, a first production item or a standard production item from the contractor's current inventory; the number of samples to be inspected as specified in 4.3; and (when applicable) the specific tests to be performed on each sample. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bid should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.4 Subject term (key word) listing.

Cattle hide
leather

6.5 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 - AV
Air Force - 99

Preparing activity:
DLA - IS

(Project 5330-2007-004)

Review activities:
Army - AR
Air Force - 71

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