

MIL-P-83461B
25 February 1980

SUPERSEDING
MIL-P-83461A
8 September 1976

MILITARY SPECIFICATION

PACKING, PREFORMED, PETROLEUM HYDRAULIC FLUID RESISTANT, IMPROVED PERFORMANCE AT 275°F (135°C)

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

1. SCOPE

1.1. Scope. This specification covers O-ring packings for use with petroleum based hydraulic fluids conforming to MIL-H-5606 and MIL-H-83282 over the temperature range of -65° to 275°F (-54° to 135°C). This material gives improved high temperature performance over materials conforming to MIL-P-25732.

1.2 Sizes. The O-rings conform to sizes shown in MIL-P-83461/1.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

FEDERAL

QQ-A-250/4	Aluminum Alloy 2024, Plate and Sheet
QQ-A-250/11	Aluminum Alloy 6061, Plate and Sheet
QQ-A-250/12	Aluminum Alloy 7075, Plate and Sheet

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Air Force Wright Aeronautical Laboratories, WPAFB, OH 45433 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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MILITARY

MIL-P-4861	Packing, Preformed, Rubber, Packaging of
MIL-H-5440	Hydraulic Systems, Aircraft, Types I and II, Design, Installation, and Data Requirements For
MIL-G-5514	Gland Design, Packings, Hydraulic, General Requirements for
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance
MIL-H-6083	Hydraulic Fluid, Petroleum Base for Preservation and Operation
MIL-S-18729	Steel Plate, Sheet, and Strip, Alloy 4130, Aircraft Quality
MIL-P-25732	Packing, Preformed, Petroleum Hydraulic Fluid Resistant, Limited Service at 275°F (135°C)
MIL-H-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft
MIL-P-83461/1	Packings, Preformed, Petroleum Hydraulic Fluid Resistant, Improved Performance at 275°F (135°C), Sizes and Tolerances

STANDARDS

MILITARY

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-413	Visual Inspection Guide for Rubber O-rings

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring 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 indicated the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

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ANST B46.1

Surface Tecture (Surface Roughness, Waviness and Lay)

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

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

AMS 5513

Steel Sheet, Strip, and Plate, Corrosion Resistant, 19Cr - 9.5Ni (SAE 30304)

AMS 5630

Steel Bars and Forgings, Corrosion Resistant, 17Cr 0.5Mo (0.95-20C) (SAE 51440)

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D1414

Rubber O-rings

(Application for copies should be addressed to American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

3. REQUIREMENTS

3.1 Qualification. The packings furnished under this specification shall be a product which has been tested and passed the qualification tests specified herein and has been listed on or approved for listing on the applicable qualified products list.

3.2 Materials. This specification originally required a specific formulation which was developed under an Air Force Materials Laboratory contract. This exact formulation is no longer required but the formulation shown below is recommended since it will meet the requirements of this specification when properly processed.

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<u>Ingredients</u>	<u>Parts by Weight</u>
Chemigum N917 ¹	100.0
Magnesium Oxide ²	5.0
Zinc Oxide ²	5.0
N330 RAF ²	40.0
N550 FEF ²	35.0
Aminox ³	1.5
Antioxidant ZMB ⁴	1.5
Dibutyloxyethyl Sebacate ⁵	10.0
Diethylhexyl Azelate ⁶	10.0
Varox ⁷	3.5

1. Source: The Goodyear Tire and Rubber Company
2. Source: Several
3. Source: Uniroyal Chemical
4. Source: Bayer
5. Source: C.P. Hall
6. Source: C.P. Hall
7. Source: R.T. Vanderbilt Co., Inc.

The cure shall be 4 minutes at 370°F. This cure has been used successfully in molds which are attached to the plates of curing presses. If the molds are not attached to the platens other curing conditions will have to be used. The alternate cure must be equivalent to the 4 minutes at 370°F cure and the material must meet the physical property requirements of this specification.

A very significant difference in the ability to withstand dynamic cycling has been noted between batches of this material. Physical property tests do not show significant differences. It appears that the age of the Varox may be a factor although this has not been proven. Work is continuing to attempt to find the exact causes of the differences in cycling. In the interim, fresh Varox should be used to make this compound. This is particularly important during production because cycling tests are not conducted as a part of quality conformance inspection. Dynamic cycling tests shall be run on samples of production batches of this material at various intervals at the discretion of the qualifying agency.

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3.3 Dimensions and tolerances. The dimensions and tolerances of O-rings procured to this specification shall conform to MIL-P-83461/1.

3.4 Physical properties. The physical properties of the rubber shall conform to the values given in Table I.

Table I. Physical Properties.

Original properties	Requirements
Specific gravity	As determined
Hardness, Type A, points	75 \pm 5
Tensile strength, psi	1350, minimum
Elongation, %	125, minimum
Tensile stress (modulus psi at 100% elongation	650, minimum
Temperature Retraction, TR-10	-49, maximum
50% elongation and 10% return, °F	
Corrosion and adhesion	Slight corrosion allowed on 4130 steel, none on other metals
After aging 70 hours at 275° \pm 5°F in MIL-H-5606	
Hardness change, Type A, points	+5, -10
Tensile strength decrease, %	50, maximum
Elongation decrease, %	35, maximum
Volume change, %	10 to 20
Compression set, 25% deflection % of original deflection	40, maximum
Temperature Retraction, TR-10	-49, maximum
50% elongation and 10% return, °F	
After aging 70 hours at 275° \pm 5°F in MIL-H-83282	
Hardness change, Type A, points	+5, -10
Tensile strength decrease, %	40 maximum
Elongation decrease, %	40 maximum
Volume change, %	5 to 15
Compression set, 25% deflection, % of original deflection	45 maximum
Temperature Retraction, TR-10	-49 maximum
50% elongation and 10% Return, °F	

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Table I. Physical properties. (Continued)

Original Properties	Requirements
After aging 70 hours at 275°F \pm 5°F in air Compression set, 25% deflection, % of original deflection	60, maximum
After aging 60 days at 75° \pm 5°F in air Compression set, 25% deflection, % of original deflection	25, maximum
After aging 60 days at 75° \pm 5°F in MIL-H-5606 Compression set, 25% deflection, % of original deflection	20, maximum

3.4.1 Variations. The permissible variations in physical properties during actual production from those values obtained in the qualification tests shall be as follows:

- a. Specific gravity \pm 0.02
- b. Tensile strength, percent \pm 20
- c. Elongation, percent \pm 20

In addition, all physical properties tested shall meet the requirement specified in Table I.

3.5 Dynamic cycling. When tested in accordance with 4.7, the O-rings shall withstand a minimum of 110,000 cycled without failure. Failure is determined as the number of cycles at which a test ring leaks a total of 70 ml of hydraulic fluid. Each test consists of 2 test cells containing 2 test rings each. A minimum of 3 test runs shall be conducted making a total of 6 test cells to be tested. The number of cycles until failure shall be recorded. The highest number of cycles and the lowest number of cycles shall be discarded. The remaining 4 values shall be averaged and that value must be 110,000 minimum for the O-rings to pass the test.

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3.6 Identification. All O-rings shall be individually packaged. Each envelope shall have the following information printed on the outside:

- a. National Stock Number.
- b. Military Part Number.
- c. Material Specification.
- d. Manufacturer's Name.
- e. Manufacturer's Compound Number.
- f. Manufacturer's Batch Number
- g. Contract Number.
- h. Cure Date.

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 facility 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 Classification of tests. The inspection and testing of the rubber shall be classified as follows:

- a. Qualification tests (see 4.3).
- b. Quality conformance inspection (see 4.4).

4.3 Qualification tests.

4.3.1 Samples. Test samples shall be O-rings conforming to Size -214 of MIL-P-83461/1. Size -218 O-rings are also required for the dynamic cycling test (see 4.7). Hardness shall be determined on hardness discs of at least 1/4 inch thickness.

4.3.2 Tests. Qualification tests shall consist of all the tests specified in 4.6 and 4.7.

4.4 Quality conformance inspection.

4.4.1 Sampling for inspection. Sampling for quality conformance inspection shall be in accordance with MIL-STD-105, except where otherwise indicated herein. Quality conformance tests are required for all production batches of material.

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4.4.1.1 Batch. A batch shall be the quantity of material compounded on a mill or mixer at one time. A batch will always have to include M83461/1 -214 O-rings and hardness discs for quality conformance tests. A batch shall consist of a maximum of 200 pounds. Quality conformance tests shall be conducted on each 200 pounds if the batch size is more than 200 pounds.

4.4.2 Quality conformance test samples. The test samples shall be Size -214 O-rings conforming to MIL-P-83461/1. Hardness discs shall be used for hardness determinations.

4.4.3 Inspection of materials and components. The supplier is responsible for insuring that materials and components used were manufactured, tested, and inspected in accordance with referenced subsidiary specifications and standards to the extent specified or if none, in accordance with this specification (see 4.1). In the event of conflict, this specification shall govern. Inspection records shall be kept complete and available to the procuring activity at all times.

4.4.4 Inspection of the end item. Examination of the end item shall be in accordance with the classification of defects, inspection levels, and acceptable quality levels (AQL'S) set forth herein. The lot size, for the purpose of determining the sample size in accordance with MIL-STD-105, shall be expressed in units of O-rings.

4.4.4.1 Examination for defects in appearance and workmanship. The examination shall be in accordance with MIL-STD-413. The sample size shall be in accordance with inspection level II of MIL-STD-105 and the AQL related to percent defective shall be 1.5.

4.4.4.2 Examination for dimensional defects. The examination shall be made to the tolerances specified in MIL-P-83461/1. The sample size shall be in accordance with inspection level II of MIL-STD-105 and the AQL related to percent defective shall be 1.5.

4.4.4.3 Examination for defects in packaging. An examination shall be made to determine that the packaging, packing, and markings comply with Section 5. The sample unit for this examination shall be one shipping container fully packed, selected just prior to the closing operation. Shipping containers fully prepared for delivery shall be examined for closure defects.

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<u>Examine</u>	<u>Defect</u>
Packaging	Not the level specified. Not packaged as specified or required. Packaging material, closures not as specified.
Packing	Not level specified; not in accordance with contract requirements. Container not as specified, closures not accomplished by specified or required methods or materials. Any nonconforming component, component missing, damaged or otherwise defective, affecting serviceability. Inadequate application of components, such as incomplete closure of case liners, containing flaps loose or inadequate strapping, bulged or distorted containers.
Count	Less than specified or indicated quantity.
Weight	Gross weight exceeds specified requirements.
Markings	Interior or exterior markings, as applicable, omitted, illegible, incorrect, incomplete or not in accordance with contract requirements. Date of cure, storage instruction missing.

The sample size shall be in accordance with inspection level II of MIL-STD-105 and the AQL related to percent defective shall be 2.5.

4.4.5 Quality conformance tests. The following tests shall be conducted on each batch of material (see 4.4.2):

Original

- Specific gravity
- Hardness
- Tensile strength
- Elongation
- Tensile stress
- Temperature retraction

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Fluid aged 70 hours at $275^{\circ} \pm 5^{\circ}\text{F}$ in MIL-H-5606

Compression set

Temperature retraction

Hardness change

Air aged 70 hours at $275^{\circ} \pm 5^{\circ}\text{F}$

Compression set

Size -214 per MIL-P-83461/1 shall be used as test samples.

Hardness discs shall be used for the hardness test.

4.4.5.1 Rejection criteria. A lot shall be rejected upon the failure of any sample to meet the test requirements specified herein. A lot that has been rejected may be reworked to correct the deficiencies and resubmitted for acceptance.

4.5 Test conditions.

4.5.1 Fluid. The fluid aging in this specification shall be conducted using hydraulic fluids qualified to MIL-H-5606 and MIL-H-83282, as applicable. New fluid shall be used for each aging test.

4.5.2 Atmospheric conditions. All fluid cooling, conditioning, and physical property determinations shall be conducted in an atmosphere of 50 ± 15 percent relative humidity and at a temperature of $75^{\circ} \pm 5^{\circ}\text{F}$.

4.6 Test Methods.

4.6.1 Physical properties. Unless otherwise specified herein, physical properties shall be determined in accordance with ASTM D1414.

4.6.2 Fluid aging. The containers used for fluid aging shall be of the conventional fruit - jar type. The cover for the container shall be either inverted in order that the lids's flat surface comes in contact with the sealing surface of the container, of a glass cover held firmly in place by a wire - lever apparatus. Unclean, uneven sealing surfaces of the cover and container and oil contact with the sealing surfaces shall be avoided. During oil aging the O-rings shall be suspended in the oil by a glass or nichrome wire rack in such a manner that the O-rings will not come in contact with any part of the container. The hardness discs shall be placed loosely in the jars. Immediately after the aging period and before physical property determination, the O-rings and hardness discs shall be cooled in new fluid for a period of not less than 30 minutes at $77^{\circ} \pm 5^{\circ}\text{F}$.

4.6.3 Corrosion and Adhesion. Size -214 O-rings, two for each metallic plate below and using whole uncut rings, shall be prepared for corrosion testing by inserting sufficient quantities of the seals in a desiccator or similar humidity chamber maintained at 92 percent minimum relative humidity and $75^{\circ} \pm 5^{\circ}$ for at least 72 hours. Plates of the metals listed below shall be polished to surface roughness of 4 to 16 RHR in accordance with ANSI B46.1. The edges shall also be polished to reduce the formation of edge corrosion. The plates shall be washed with toluene or aliphatic naphtha, or similar degreasing agent that will produce a clean dry surface free from film. The metals used shall be as follows:

QQ-A-250/4	Aluminum Alloy 2024
QQ-A-250/11	Aluminum Alloy 6061
QQ-A-250/12	Aluminum Alloy 7075
AMS 5630	440C Stainless Steel
AMS 5513	304 Stainless Steel
MIL-S-18729	4130 Steel, Aircraft Quality

The humidified seals and the metallic plates shall be immersed to MIL-H-6083, Type I fluid and drained to the drip point. The seals and plates shall then be so laid together in a stack that at least two whole seals 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 maintained at not less than 92 percent relative humidity at $75^{\circ} \pm 5^{\circ}$ F. This relative humidity may be produced by the use of a salt of sufficient concentration in solution with distilled water. No more than 15 minutes should be required for assembling the test samples. Time of humidity exposure for this portion of test shall be 14 days. At the termination of this test, the procedures outlined below shall be followed:

a. The surface of the plates which were in contact with the seals shall be inspected for discoloration, deposits, pitting, or other evidence of corrosion or adhesion. If any exist, the surfaces of the plates shall be washed in aliphatic naphtha. Deposits determined as rubber compounds or elements therefrom, which can be removed by this process and which do not occur on other surfaces of the plates, shall be construed as adhesion.

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b. 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. If any doubt should arise about the presence of pitting, erosion or corrosion on the metal plates from the O-rings, a microscope of approximately 10- or 15-power magnification shall be used to determine the actual condition.

4.7 Dynamic cycling. The dynamic cycling shall be performed on a rod seal test apparatus. The apparatus, as shown in Figure 1, is capable of evaluating O-rings under a high pressure, high temperature, cycling environment until failure. The test cells are run concurrently with O-rings in each cell. A test cell is shown in Figure 2. The testing environments are:

- a. Test temperature - 275°F (135°C).
- b. Pressure - 1500 psig (10,300 kPas).
- c. Stroke length - 4 inches (10.2 cm).
- d. Cycling rate - 30 cycles/min where one cycle is defined as both the forward and return strokes.
- e. Pressure is to be applied for one complete cycle and pressure is to be reduced to zero during the next cycle.
- f. Hydraulic fluid - MIL-H-5606.
- g. Tests are to be conducted without back-up rings. A steel spacer is to be used to maintain the proper gap dimension.
- h. Dimetral clearance between rod and cell to be maintained at 0.004 inch (0.0102 cm).
- i. Surface finish on test rods to be between 10-20 micro-inches.

4.7.1 Procedure. The procedure to be used in conducting dynamic O-ring evaluations is as follows:

- a. Select 4 size -214 unaged or unconditioned O-rings.
- b. Lubricate the rings with fresh MIL-H-5606 hydraulic fluid and assemble the rings and spacers into the test cylinders shown in Figure 3.
- c. Rod and gland dimensions are to conform to MIL-C-5514.
- d. Fill with MIL-H-5605B hydraulic fluid taking care to exclude entrapped air.
- e. Bleed system at test cell locations to remove entrapped air in lines.
- f. Check of final test cells installation in test fixtures and insure that the test cells do not translate along the rod by more than 0.005 inch (0.0127 cm).

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(A) CRANK STROKES
 10.2 mm { 0.4 in. }
 50.8 mm { 2.0 in. }
 101.6 mm { 4.0 in. }

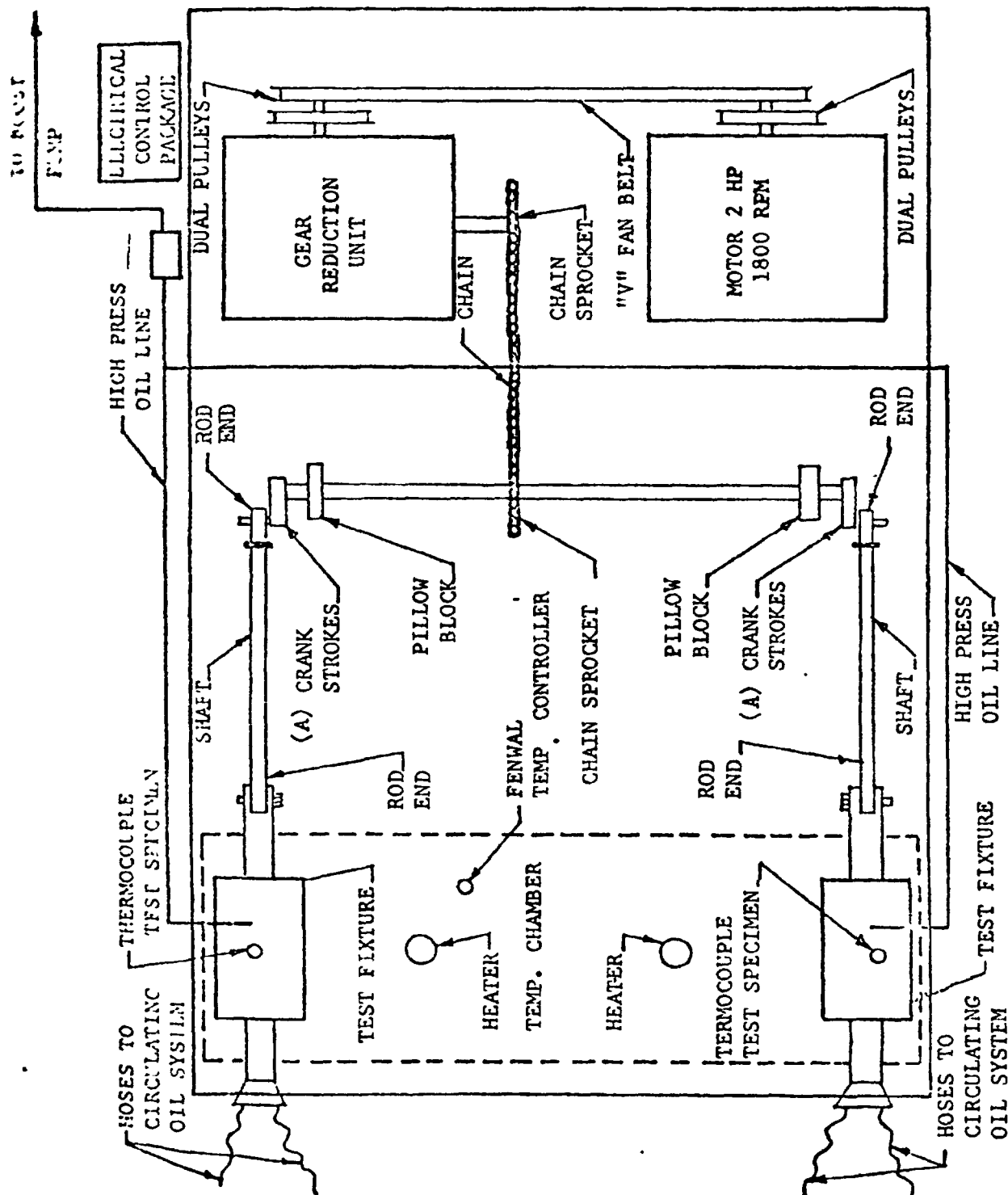
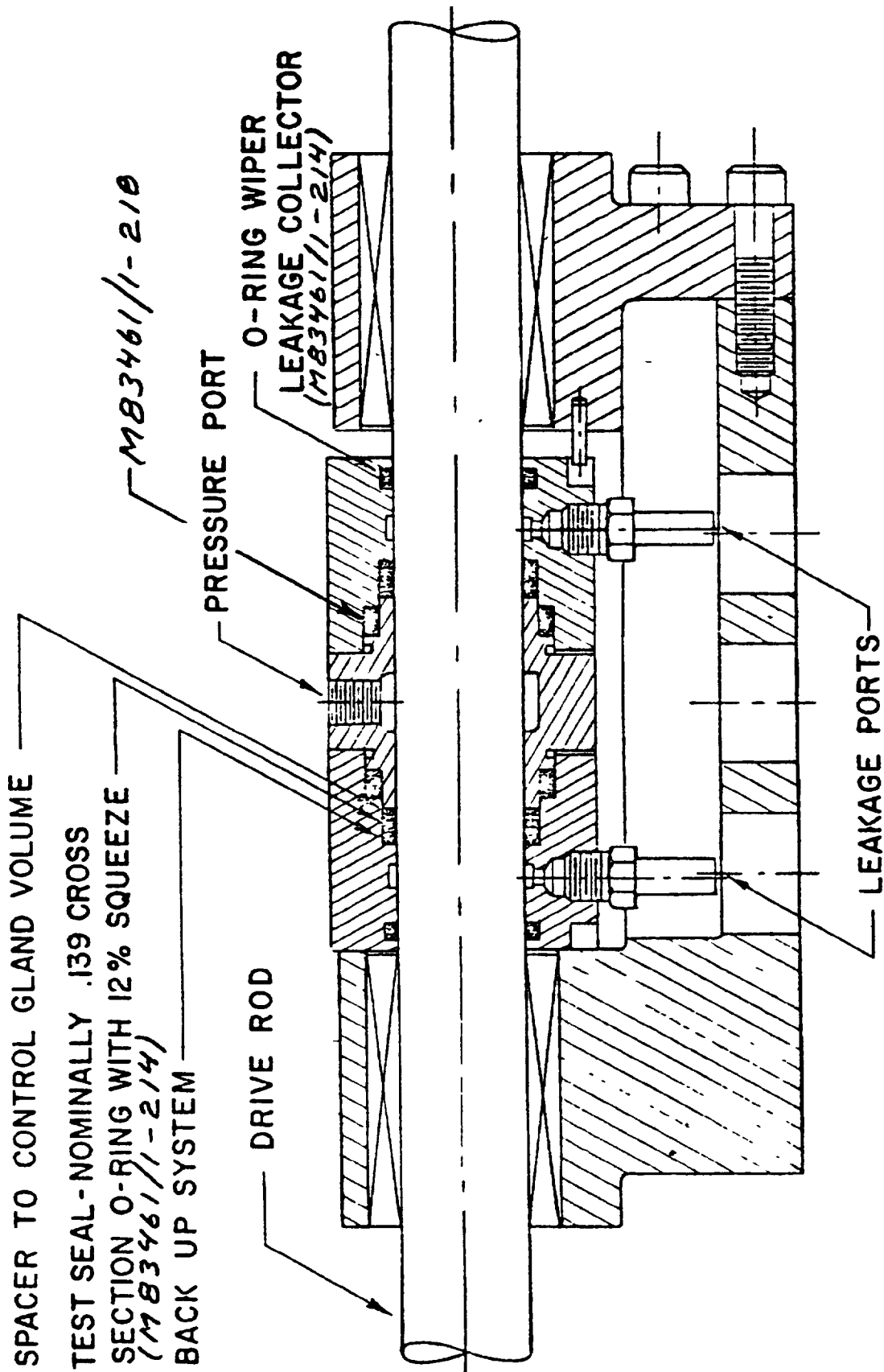


FIGURE 1. O-RING CYCLE TEST SET UP

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ONE INCH ROD TEST FIXTURE - VARIABLE STROKE

FIGURE NO. 2 Complete Assembly of Test Cell

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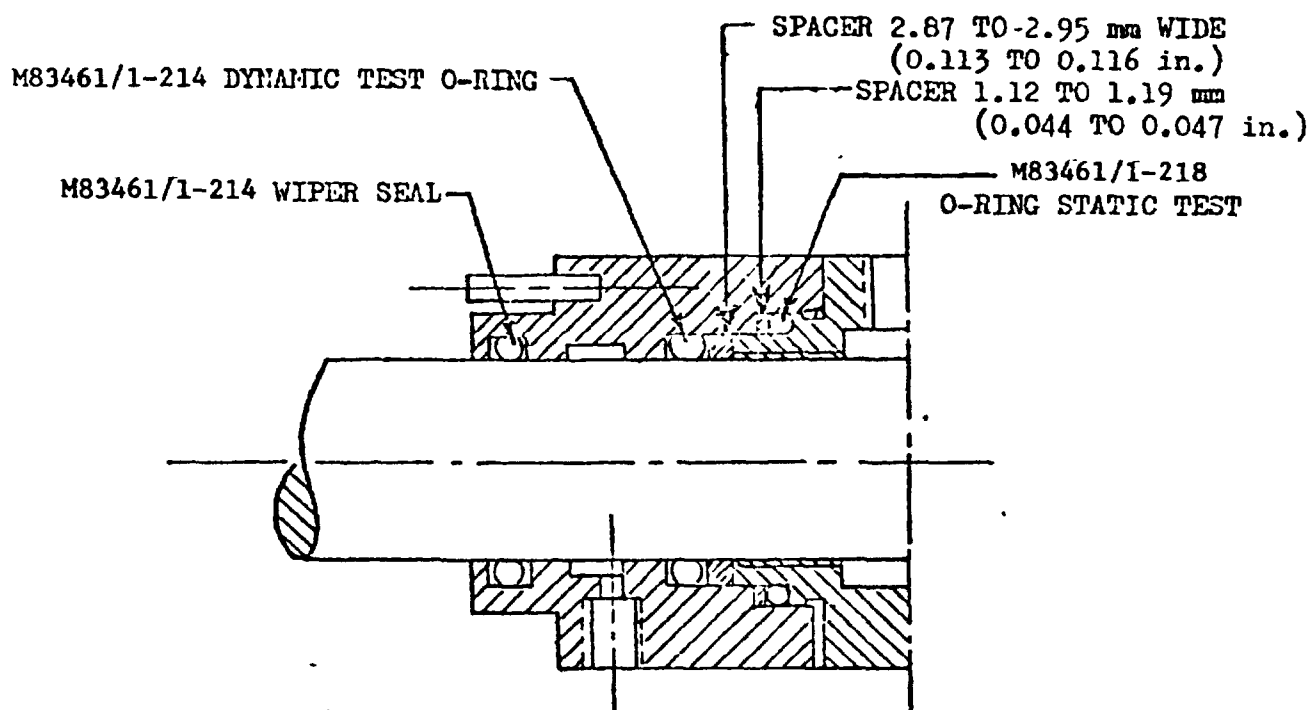


FIGURE 3. CYLINDER ASSEMBLY WITHOUT BACK-UP RINGS

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g. Set dynamic conditions as follows:

1. stroke - 4 inches (101.6 mm),
2. rate - 30 cycles/minute,
3. pressure - 1500 psig (10,300 kPasc),
4. temperature - 275°F (135°C),
5. start tests by turning on heating elements,
6. start test cell temperature recorder to record the temperature of each cell throughout the test,
7. After temperature reaches the predetermined set point, start cycling and adjust temperature as required, and
8. start leakage rate recorder at the same time that cycling is initiated.

h. Cycle O-rings at given set of conditions until failure of the rings.

i. Failure is specified as the number of cycles at which either test ring in either test cell leaks a total of 70 ml of hydraulic fluid. At this point, the test cell having the failed ring will be shut down and the remaining cell operated until one or both of the two remaining test rings fail by leaking more than 70 ml of hydraulic fluid.

4.7.2 Interpretation and data recording. Each test ring will be analyzed to determine if possible, the mode of failure. The method of inspection will be as follows:

- a. Carefully disassemble each test cell.
- b. Note the position and condition of each test ring prior to removal.
- c. Inspect test cell for wear caused by the test rod touching the cell during cycling.
- d. Carefully inspect each ring for cause of failure. Note as to whether the ring was nibbled or whether it had been extruded, pinched, or cracked. Also note any set the ring may have taken.

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e. Note if total leakage occurred slowly over a long period of time or if it occurred suddenly over a short number of cycles.

f. Note any twisting, turning, or preferential wear patterns on test ring.

g. Photograph each ring for permanent record of wear pattern.

h. Record number of cycles to total leakage of 70 ml.

4.7.3 Repeat testing. A minimum of 3 test runs using 2 test cells each time shall be conducted for qualification testing. The highest number of cycles and the lowest number of cycles shall be discarded. The remaining 4 values shall be averaged.

5. PACKAGING

5.1 Preservation, packaging, packing, and marking. Unless otherwise stipulated by the procuring activity, preservation, packaging, packing and marking shall be in accordance with the applicable requirements of MIL-P-4861 as specified (see 6.2).

6. NOTES

6.1 Intended use. This specification covers O-rings intended for use at a temperature range of -65° to 275°F in hydraulic systems in accordance with MIL-P-5514 and MIL-H-5440. These rings are suitable for use with hydraulic fluids conforming to MIL-H-5606 and MIL-H-83282. This material gives improved high temperature performance over materials conforming to MIL-P-25732.

6.2 Ordering data. Procurement documents shall specify:

a. Title, number and date of this specification.

b. Sizes per MIL-P-83461/1.

c. Quantity.

d. Applicable federal stock number.

e. Applicable levels or preservation, packaging and packing required (see 5.1).

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6.3 Qualification. With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, been tested and approved 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 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 in the Air Force Wright Aeronautical Laboratories, Attn: MLSA, Wright-Patterson AFB, Ohio 45433 and information pertaining to qualification of products may be obtained from that activity.

Custodian

Air Force - 11
Army - AV
Navy - AS

Preparing Activity:

Air Force - 11

Project Number: 5330-0510

Reviewer:

Air Force - 99
DLA - IS

User:

Air Force - 99
Army - ME

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DOCUMENT IDENTIFIER (Number) AND TITLE

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1 OCT 76

1426

PREVIOUS EDITION WILL BE USED

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