

INCH-POUND

MIL-DTL-5516D
15 MAY 2008
SUPERSEDING
MIL-P-5516C
5 January 1967

DETAIL SPECIFICATION

Packing, Preformed, Petroleum Hydraulic
Fluid Resistant, 160°F (71°C)

Inactive for new design after 25 September 1980

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

1. SCOPE

1.1 Scope. This specification covers preformed packings for use where resistance to hydraulic fluid conforming to specification MIL-PRF-5606 is required at temperatures from -65° to 160°F (-54° to 71°C).

1.2 Classification. Packings are made from the following class of synthetic rubber as specified (see 6.2).

Class A - Low Flexibility

Note: Class B (High Flexibility) has been canceled and replaced by MIL-P-25732.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 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.

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 email to dscpg&ispeccomments@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>.

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FEDERAL STANDARDS

FED-STD-601 Rubber; Sampling and Testing

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-G-5514 Gland Design; Packings, Hydraulic, General Requirements For
(Inactive for new design)
MIL-PRF-5606 Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance
(Inactive for new design)
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) (Inactive for new design)

DEPARTMENT OF DEFENSE STANDARDS

AN6225 Packing – “V” Ring Hydraulic (Inactive for new design)

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 Brass Plate, Sheet, Strip, and Rolled Bar
ASTM B139/B139M Phosphor Bronze, Rod, Bar, and Shapes
ASTM D91 Precipitation Number of Lubricating Oils
ASTM D412 Vulcanized Rubber and Thermoplastic Elastomers – Tension
ASTM D573 Rubber – Deterioration in an Air Oven
ASTM D792 Density and Specific Gravity (Relative Density) of Plastics by
Displacement
ASTM D2240 Rubber Property – Durometer Hardness

(Copies of these documents are available from www.astm.org or the American Society for Testing and Materials, 10 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-6758 Steel, Chrome-Molybdenum (4130) Bars and Reforging Stock
(Aircraft Quality)
SAE-AMS 6345 Steel Sheet, Strip, and Plate 0.95 Cr – 0.20 Mo (0.28 – 0.33C)
(SAE 4130) Normalized or Otherwise Heat Treated
SAE-ARP-5316 Storage of Elastomer Seals and Seal Assemblies which
Include an Elastomer Element Prior to Hardware Assembly

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

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2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the 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 Specification sheets. The individual item requirements shall be as specified herein and in accordance with AN6225. In the event of any conflict between the requirements of this specification and AN6225, 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 packings shall be manufactured from a synthetic rubber which is compatible with hydraulic fluid conforming to specification MIL-PRF-5606. The synthetic rubber shall contain no substances which will adversely affect the properties of the fluid or the packings.

3.4 Design and construction.

3.4.1 Dimensions. Dimensions and tolerances shall be as specified on AN6225 or in the contract (see 6.2).

3.4.2 Splicing. Splicing of cured rubber shall not be used in the manufacture of the packings. Splicing of uncured stock is allowable.

3.5 Physical properties. Physical properties of the synthetic rubber shall conform to Table I.

3.5.1 The maximum permissible variations in original physical properties during actual production from those values established during qualification tests shall be within the limits specified in Table II, but must stay within the limits specified in Table I.

3.6 Finish. Mold flash shall be removed from the packings in such a manner that they conform to the requirements specified herein and on applicable standards. All surfaces of the packings shall be reasonably free from defects, blemishes, or irregularities. Reasonable shall be defined as allowing minor pits, raised spots, or tool marks which shall not be greater than 0.003 inch (0.076mm) in height or depth from the packing surface.

3.7 Performance.

3.7.1 Leakage and breakout. Packings shall not exceed specified values when tested as described in section 4. There shall be no evidence of wear, extrusion, disintegration, or excessive permanent set.

3.7.2 Cycling. Packings shall withstand the operations specified in section 4. Leakage shall not exceed values specified in section 4. After test, the packings shall be serviceable with no evidence of cracking, flaking, excessive wear, or other malfunctioning.

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Table I. - Original physical properties

Property	Class A
Specific gravity	As determined ¹
Hardness at 24° ± 3° C.(75° ±5°F) shore A durometer, minimum	88
Tensile strength, psi	As determined
Elongation, ultimate, percent	As determined
Tensile stress (modulus), psi at 100 percent elongation	Not required
Permanent set, percent	As determined at 50 percent elongation
Permissible change in original physical properties after oil and air aging	
Tensile strength, change percent	As determined
Elongation change, percent	As determined
Hardness change, points, Shore A durometer	As determined (See 4.5.2)
Permanent set (list actual value)	As determined
Volumetric change upon aging in hydraulic oil, percent ²	0 to +5 percent ²
Corrosion adhesion	None ²

¹ Tests are to be made on AN6225 V-rings. All other tests are to be performed on platen sheets or hardness samples, as applicable. (Hardness shall not be determined from actual packing rings).

² Tests are to be made on AN6225 V-rings.

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TABLE II. Maximum production permissible variations in physical properties from contractors' first article values.

Property	Class A
Specific gravity, points	$\pm 0.02^1$
Hardness, shore A durometer at $24^\circ \pm 3^\circ\text{C}$. ($75^\circ \pm 5^\circ\text{F}$), points	$\pm 3^2$
Tensile strength, percent	± 15
Elongation, percent	± 20
Modulus, pounds, percent	Not required
Permanent set, percent	± 20
Corrosion and adhesion	Slight corrosion on steel
Volume change	Swell determined from first article test value ± 2 (see example ³) but must stay within limits specified in Table I.

¹ If basic specific gravity is 1.30, then limits can be 1.28 to 1.32.

² Shore hardness on production samples shall be not less than 85 for class A material with this tolerance applied.

³ Example: If first article swell of V-ring is +1 percent, then limits can be 0 to 3 percent; if +5 percent, then limits can be 3 to 7 percent; or if +8 percent, then limits can be 6 to 10 percent.

3.8 Identification of product. The following general marking shall be used, unless otherwise specified by the procuring activity.

3.8.1 V-ring packings shall have the manufacturer's trademark and the applicable size dash number molded into the surface of the inner Vee close to the apex of the angle. If any other marking is used, it shall be specially approved by the procuring activity. If raised figures are used, the height shall not exceed 0.010 inch (.254mm).

Table III. - Test samples required for First Article tests

Physical Property Test

Tests	AN6225 V-ring	
	-20	-25
Unaged samples (table I):		
Specific gravity		
Tensile strength and elongation		
Tensile stress (modulus)		
Permanent set		
Corrosion and adhesion	5	
Air-aged (table I):		
Tensile strength and elongation		
Permanent set		
Oil-aged (table I):		
Tensile strength and elongation		
Permanent set		
Volumetric change	6	6
Subtotal (physical)	11	6

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Table III. - Test samples required for First Article tests (cont'd)

Performance and Endurance Tests

Tests	AN6225 V-ring	
	-20	-25
Endurance (unaged)	2	4
Performance and endurance (aged)	4	4
Subtotal (Performance)	6	8
Total (all tests)	17	14

3.9 Age. Unless otherwise specified the age limitations for the finished product shall conform to SAE-ARP 5316.

3.10 Workmanship. Workmanship and finish shall be in accordance with the highest grade practice in manufacturing this kind of product. Manufacturing practices shall be such that the physical properties of the finished product shall be uniform through the cross section of the packing.

4. VERIFICATION

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

- a. First article inspection (see 4.2).
- b. Conformance inspection (see 4.4).

4.2 Inspection conditions. Unless otherwise specified (see 6.2) all inspections shall be performed in accordance with the applicable test conditions specified in FED-STD-601.

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:

Class A material

17 AN6225-20

14 AN6225-25

3 Platen press sheets, .075 inch (1.905mm) x at least 4.75 inch (120.65mm) x 4.75 inch (120.65mm)

3 ASTM hardness test disks, .25 inch (6.35mm) thick by 1 inch (25.4mm) diameter

4.3.1.1 Platen press sheets and discs shall have the same compounding and equivalent cure as the accompanying packings, and the packings shall represent the manufacturer's production product, particularly with respect to stock preparation, mold design and finish, and molding technique. Proper identification shall be applied to each packing using expected production marking compound and technique and color

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4.3.2 Test report. Contractor shall furnish test reports in accordance with MIL-HDBK-831, the requirements below, any other requirement specified by the procuring activity.

- a. The report shall contain a tabulation of the physical property values obtained during first article tests.
- b. The report shall contain a complete set of photographs showing the packing as mounted for each test and showing details of any failures encountered.
- c. Diagrams of test setups shall be provided when not self-explanatory by the photographs.

4.3.3 Tests. First article inspection shall consist of all the following tests:

Class A

- | | | |
|-----|--|--------------------------|
| (a) | Examination of product | (4.4.1) |
| (b) | Specific gravity (new only) | (4.5.1.4) |
| (c) | Shore durometer hardness (new, air and oil aged) | (4.5.1.1) |
| (d) | Tensile strength (new, air and oil aged) | (4.5.1.2) |
| (e) | Ultimate elongation (new, air and oil aged) | (4.5.1.2) |
| (f) | Permanent set (new, air and oil aged) | (4.5.1.2 and
4.5.1.3) |
| (g) | Corrosion and adhesion (new only) | (4.5.3) |
| (h) | Volume change (oil aged only) | (4.5.2.2) |
| (i) | High and low temperature performance | (4.5.4.1 and
4.5.4.2) |
| (j) | Endurance cycling tests | (4.5.5.1 and
4.5.5.2) |

4.4 Conformance inspection.

- | | | |
|-----|--------------------------|---------|
| (a) | Examination of product | (4.4.1) |
| (b) | Batch tests | (4.4.2) |
| (c) | Finished product tests | (4.4.3) |
| (d) | Process monitoring tests | (4.4.4) |

4.4.1 Examination of product. Each packing and gasket shall be carefully examined to determine conformance to the applicable drawings, workmanship, finish, marking and applicable standards.

4.4.1.1 Dimensions. Packings shall be checked for cross-sectional dimensions and inside and outside diameters. All dimensions shall conform to the applicable standards as specified in 3.4.1, "Shape and dimensions." The cross section and stack height of V-ring packings shall be checked in "go" and "no go" templates similar to the type indicated in figure 1. Diameters and concentricity of V-rings shall be checked as shown in figure 2, sheets 1 and 2. The general type of gage shown in figures 1 and 2 may be used in applicable form on other types of packing.

4.4.2 Batch tests. The batch shall consist of the quantity of material compounded at any one time and ready for molding and curing into the finished product. Acceptance of the batch shall in no case be construed as a guaranty of the acceptance of the finished product.

4.4.2.1 Test specimens. Test specimens shall be molded from each batch and finished with the same state of cure as the finished product. Test specimens for the purpose of batch testing shall consist of one compression molded hardness specimen (.25 inch (6.35mm) thick and 1 inch (25.4mm) diameter minimum) and three dumbbell specimens cut with a C die, conforming to ASTM D412, obtained from one .075 inch (1.905mm) thick platen sheet.

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4.4.2.2 Tests. The tests shall consist of those tests specified under "Test Methods" (4.5) for the following properties:

- | | | |
|-------|---------------------------|-----------|
| (a) | Hardness | (4.5.1.1) |
| (b) | Specific gravity | (4.5.1.4) |
| * (c) | Tensile strength | (4.5.1.2) |
| * (d) | Ultimate elongation | (4.5.1.2) |
| * (e) | Modulus @ 100% elongation | (4.5.1.2) |

* (To be used for monitoring only since values for dumbbells were not established at first article -- not cause for rejection in this case. Values shall be recorded as part of the inspection records.)

4.4.2.3 Rejection and retest. Failure of any of the test specimens to conform to the acceptance requirements of this specification shall be cause for rejection of the batch represented. A batch that has been rejected may be reworked to correct the deficiencies and re-submitted for acceptance.

4.4.3 Finished product tests. Tests shall be performed on unaged specimens from each day's production of the specific sizes for which physical property values were established at first article. These specimens shall be provided by the manufacturer, molded concurrently with other production parts. Variation in physical properties shall not exceed those specified in Table II and those contained in the First Article Approval Report.

4.4.3.1 Test specimens. For Class A material, one platen sheet (.075 inch (1.905mm) x at least 4.75 inch (120.65mm) x 4.75 inch (120.65mm)) shall be molded concurrently with other production parts using the same production techniques.

4.4.3.2 Tests. The tests shall consist of those tests specified under "Test Methods" (4.5) for the following properties:

- | | |
|-----|---------------------------|
| (a) | Specific gravity |
| (b) | Tensile strength |
| (c) | Ultimate elongation |
| (d) | Modulus @ 100% elongation |

4.4.3.3 Rejection and retest. Failure of any of the test specimens to conform to the acceptance requirements of this specification shall require a retesting of an additional set of test specimens. In the event of failure of any specimens in the retest, the finished products represented by the specimens shall be withheld from acceptance until the extent and cause of failure has been determined and correction verified by additional tests.

4.4.4 Process monitoring test. Tests shall be performed at six month intervals on unaged specimens of the specific sizes for which physical property values were established at first article. These specimens shall be provided by the manufacturer, molded concurrently with other production parts.

4.4.4.1 Test specimens. For Class A material, eight AN6225-20 V-rings and two .075 inch (1.905mm) thick dumbbells shall be selected at random from production or shall be molded concurrently with other production parts using the same production techniques.

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4.4.4.2 Tests. The tests shall consist of those tests specified under "Test Methods" (4.5) for the following properties, using the number and sizes of specimens indicated:

Class A Material

- (a) Permanent set
- (b) Corrosion and adhesion
- (c) Volume change

4.4.4.3 Rejection and retest. Failure of any of the test specimens to conform to the process evaluation requirements of this specification shall require a retesting of an additional set of specimens. In the event of failure of any of the test specimens in the retest no finished products on hand or later production shall be accepted until the extent and cause of failure have been determined, corrected and action taken to preclude recurrence. After correction, all of the tests in 4.4.3.2 will be repeated. Full particulars concerning the failure and action taken to correct the deficiencies shall be recorded as part of the inspection records.

4.4.4.4 Test conditions. The test fluid shall be an oil which has been listed or approved for listing on QPL-5606 with 26 - 28% swell of standard synthetic rubber. The oil and samples to be aged shall be put into a non-pressurized closed container or a reflux-type condenser to prevent distillation of the volatile matter in the fluid. A new batch of fluid shall be used for each aging test. In all cases, the ratio of quantity of fluids to the weight of the seals being aged shall be 20 ml of fluid for every gram of seals. Seals shall be loosely separated in the fluids.

4.5 Test methods.

4.5.1 Original physical properties of material. The physical properties listed below shall be determined as specified in the following ASTM Standard Test Methods, table I herein, and as noted. During first article tests only, the manufacturer shall report all values for each sample tested as well as the average value for each size:

- (a) Hardness: ASTM D2240
- (b) Tensile strength: ASTM D412
- (c) Ultimate elongation: ASTM D412
- (d) Tensile stress (modulus): ASTM D412
- (e) Permanent set: See 4.5.1.3
- (f) Specific gravity: ASTM D792

4.5.1.1 Hardness. Hardness of class A compounds shall be determined as specified in 4.5.1, except that test samples shall be compression molded .25 inch (6.35mm) thick, and shall be no smaller than 1 inch (25.4mm) in diameter. Two .125 inch (3.175mm) sheets shall not be used. Hardness checks shall not be made on actual packings.

4.5.1.2 Class A material specimens. Tensile strength, ultimate elongation, tensile stress (modulus), and permanent set, of class A material only, shall be made on standard dumbbell specimen made of .075 inch (1.905mm) platen sheets. (See 4.5.1)

4.5.1.3 Class A material permanent set. Permanent set test for Class A material shall be made by stretching the dumbbell specimen at the rate of 2 inches (50.8mm) per minute to an elongation of 50 percent, holding for 10 minutes, releasing the load, and measure set after 10 minutes' rest.

4.5.1.4 Specific gravity. Specific gravity for class A materials shall be determined on the finished AN6225 rings.

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4.5.2 Physical properties after aging.

4.5.2.1 Change in tensile strength, elongation, permanent set, and hardness. Air aging of samples (see tables I and III) shall be conducted as specified in ASTM D573. Oil aging shall be accomplished by immersing in Specification MIL-PRF-5606 hydraulic oil, for a period of 7 days at $70^{\circ} \pm 1^{\circ}\text{C}$ ($158^{\circ} \pm 2^{\circ}\text{F}$). The tensile strength, elongation, permanent set, and hardness shall be determined on the aged specimens in accordance with 4.5.1. The percentage difference between aged and unaged values for tensile strength and elongation (table I), and the actual values for change in hardness and permanent set (table I) shall be recorded.

4.5.2.2 Volumetric change. Swelling shall be determined as specified in Federal Test Method Standard No. 601, Method 6211, except the specimens shall be first article sample packings or gaskets of the sizes and quantities listed in table III. The period of immersion shall be 7 days. The fluid shall be hydraulic oil conforming to Specification MIL-PRF-5606, as specified in 4.4.4.4, maintained at a temperature of $70^{\circ} \pm 1^{\circ}\text{C}$ ($158^{\circ} \pm 2^{\circ}\text{F}$). The volumetric change shall not exceed the value specified in table I.

4.5.3 Corrosion and adhesion. Packings or gaskets of the type required for first article tests, in quantities and sizes specified in table III, 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 at $24 \pm 2^{\circ}\text{C}$ ($75^{\circ} \pm 5^{\circ}\text{F}$), temperature for 72 hours minimum. Metallic plates of the metals listed below shall be polished to a surface roughness of 5 to 15 microinches 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 ASTM D91, or similar degreasing agent. The metals used shall be as follows:

- (a) Aluminum alloy: Specification SAE-QQ-A-250/4
- (b) Brass: Specification ASTM B36/B36M
- (c) Phosphor bronze: Specification ASTM B139/B139M
- (d) Steel: Specification SAE-AMS6345

The humidified seals and the metallic plates shall be immersed in Specification MIL-PRF-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 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 $24^{\circ} \pm 3^{\circ}\text{C}$ ($75^{\circ} \pm 5^{\circ}\text{F}$). (Di-potassium acid phosphate, K_2HPO_4 , when placed in distilled water in sufficient quantity to produce a concentrated 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 acceptance tests and 14 days minimum for all first article test analyses. No more than 15 minutes should elapse between the time the test samples are removed from the prehumidifying chamber and placed in the stacked condition in the second humidity chamber. At the termination of this test, the procedure outlined below shall be followed:

(1) The surfaces of the plates which were in contact with the seals shall be inspected for discoloration, deposits, pitting, etc. If any exists, the surfaces of the plates shall be washed in precipitation naphtha. Deposits determined as rubber compounds or elements therefrom, which can be removed by this process and which do not occur on the separate control plates, shall be construed as adhesion.

(2) 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 surface 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, a microscope of approximately 10- to 15-power magnification shall be used to determine the actual condition.

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4.5.4 Performance tests. The following performance tests shall be conducted in the sequence listed. All packings shall be installed in the applicable glands of a test cylinder similar to figure 3, and the cylinder filled with hydraulic oil conforming to Specification MIL-PRF-5606 at no pressure. The cylinder with packings installed shall be maintained at $70^{\circ} \pm 1^{\circ}\text{C}$ ($158^{\circ} \pm 2^{\circ}\text{F}$) for 6 days prior to performance tests. All packings and the metals in contact with the packings shall be inspected at termination of this period for sticky or gummy residue, permanent set, or swelling of the packings and discoloration or corrosion of the metals. These data shall be recorded for use in conjunction with later results of the test for evaluation of performance.

4.5.4.1 High-temperature performance.

4.5.4.1.1 High-temperature leakage. At completion of the preceding preparation, the packings shall be installed in a controlled temperature chamber as indicated in figure 4 (only the apparatus indicated within the upper left-hand corner of figure 4 is applicable to this test). The hydraulic fluid used for testing shall be the type conforming to Specification MIL-PRF-5606. The pressure in the entire system shall be raised to 1,500 psi (10.34 Mpa) with the piston near one end of the cylinder, but not bottomed, and necessary valves adjusted to prevent motion. The temperature in the test box shall be raised to 71°C (160°F) minimum within a period of 60 minutes, and shall remain at this temperature and pressure for 24 hours. Upon completion of the 24-hour period, the following cycling and static operations shall be accomplished in the order listed. (The specified temperature shall be maintained throughout the test.)

(a) High-pressure cycling. At least 10 cycles of operation at a 1,500 psi (10.34 Mpa) pressure shall be made by opening the proper valves between the cylinder and the accumulator and bleeding pressure from the opposite end of the cylinder to the reservoir.

(b) Low-pressure cycling. At least 10 cycles of operation at low pressure shall be made by opening the proper valves between the cylinder and the reservoir and bleeding just enough pressure from the accumulator to cycle the cylinder at slow motion. The pressure shall be recorded.

(c) Low-pressure static. The hydraulic pressure in the test cylinder shall be lowered to 5 to 10 psi (.034 to .069 Mpa) pressure and the installation allowed to set for 1 hour to determine low-pressure static leakage.

The total leakage during entire test shall not exceed three drops (approximately 0.15 cc) from each packing gland. The leakage shall be recorded.

4.5.4.1.2 High-temperature breakout. Upon completion of the high temperature leakage test, the hydraulic pressure in the entire system shall be again pumped up to 1,500 psi (10.34 Mpa). With the piston held static and a 1,500 psi (10.34 Mpa) pressure maintained, the temperature in the box shall be maintained at 71°C (160°F) minimum for 3 hours after which time the source of heat shall be turned off and the entire apparatus allowed to cool to room temperature over approximately a 20-hour period. Pressure shall not fall below 1,000 psi (6.89 Mpa) during this 20-hour period. A no-load breakout test shall then be performed by closing the valve between the accumulator and cylinder, exhausting the pressure in each end of the test cylinder simultaneously, and recording the lowest pressure necessary to start motion of the piston. The pressure required for breakout shall not exceed 30 psi (.207 Mpa) for V-ring packings. Leakage during the period of this portion of the test shall not exceed two drops (approximately 0.10 cc) per gland. Breakout pressure and leakage shall be recorded.

4.5.4.2 Low-temperature performance.

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4.5.4.2.1 Leakage at low temperature. The same apparatus and packing rings used in previous tests shall be charged to 1,500 psi (10.34 Mpa) at room temperature, the accumulator pressure isolated from the test cylinder by closing the valves between the cylinder and accumulator and the cylinder pressure allowed to fall to 5 to 10 psi (.034 to .069 Mpa). Temperature shall be lowered to the range of -54° to -57°C. (-65° to -70°F) within 1 hour and held for at least 72 hours. The following cycling and static operations shall then be performed in the order specified, using fluid no warmer than -54°C (-65°F):

(a) Low-pressure cycling. At the end of this time, the piston shall be cycled at no-load pressure for at least 10 cycles by opening the proper valves between the cylinder and reservoir and bleeding sufficient pressure from the accumulator to move the piston at the minimum pressure not to exceed 50 psi (.345 Mpa). The pressure shall be recorded. (The pressure in the cylinder shall not be permitted to exceed 50 psi (.345 Mpa) at any time during these 10 cycles, as by bottoming the piston, etc.).

(b) High-pressure cycling. The piston shall be cycled under high-pressure operation for at least 10 cycles by opening the proper valves between the cylinder and accumulator and bleeding pressure from the opposite end of the cylinder to the reservoir. Minimum cycling pressure permitted during this test is 1,500 psi (10.34 Mpa).

(c) High-pressure static. With the valves closed between the cylinder and the reservoir, the valves between accumulator and cylinder shall be opened to allow a static pressure of 1,500 psi (10.34 Mpa) minimum to both sides of piston without causing motion. The apparatus shall be allowed to set for 1 hour. Pressure shall then be reduced to zero psi and the apparatus allowed to warm up to room temperature over an 18-hour period.

NOTE: At the start of (a), (b), and (c), the piston rod shall be forcefully moved from side to side in each of two planes, 90° apart.

Leakage during this entire test shall not exceed 20 drops (approximately 1.0 cc) per gland. Leakage for V-rings during the entire test shall not exceed 10 cc per gland. There shall be no evidence of wear, permanent set, or extrusion of the seals, or corrosion, sticking, or bad discoloration of the adapters or metals adjacent to the packings after or during the entire performance tests. The leakage shall be recorded.

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4.5.5 Endurance tests.

4.5.5.1 Cycling tests of aged ring. The same packings as were used in the performance test (4.5.5) shall be reinstalled in a test cylinder conforming to figure 5. The cylinder shall be installed in a test apparatus conforming or equivalent to figure 4 (only the portion of figure 4 deleting temperature apparatus is applicable to this test). This test machine shall be so constructed that during the filling stroke of the inboard end of the cylinder (at which time the piston rod is retracting), the fluid pressure shall be atmospheric or less (5 to 14.7 psi (.034 to .101 Mpa) absolute pressure). Test conditions shall be as follows:

Oil: Specification MIL-PRF-5606

Temperature: $49^{\circ} \pm 6^{\circ}\text{C}$ ($120^{\circ} \pm 10^{\circ}\text{F}$).

Stroke: 4 inch (101.6mm) minimum

Operating pressure: 1,100 to 1,500 psi (7.58 to 10.34 Mpa) driving, and 1,500 psi (10.34 Mpa) minimum loading.

Rate of cycling: 30 cycles per minute minimum, total 70,000 cycles minimum with thick (nonbreathing) cylinders used.

Standby period: Internal pressure of 1,500 psi (10.34 Mpa) shall be applied statistically for at least a 17-hour period after every second days' cycling. Standby pressure shall be 5 to 10 psi (.034 to .096 Mpa) during all other periods. In no case, however, shall more than 10,000 cycles be made between two standby periods

All test data shall be recorded

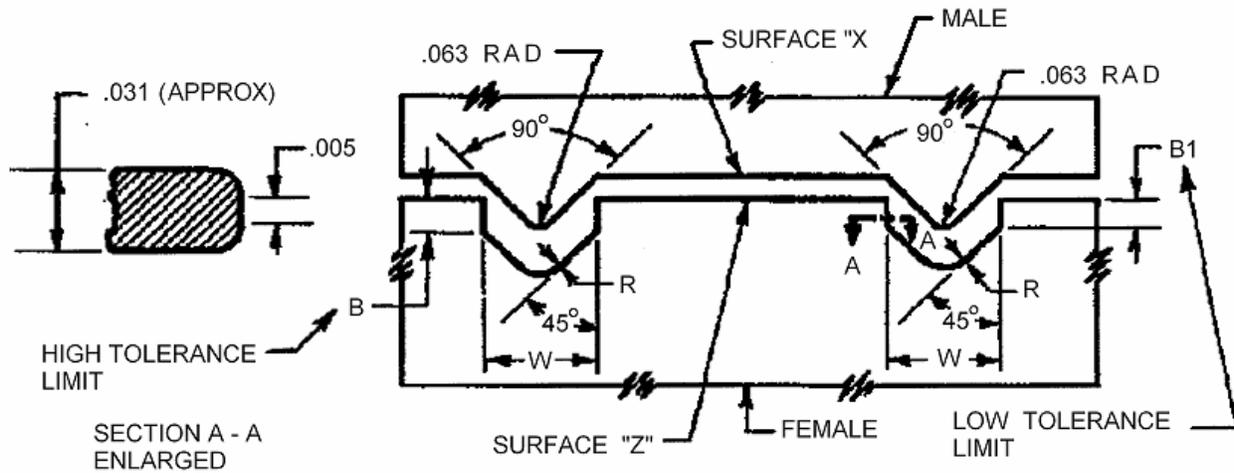
4.5.5.1.1 Leakage during entire cycling test, including standby, shall not exceed an average of 1cc per 1,000 cycles of operation (approximately 2 drops per 100 cycles) per gland. Leakage over the last 5,000 cycles of operation shall not exceed 10 cc. The leakage shall be recorded.

4.5.5.2 Cycling tests of new rings. A second set of new packing rings (as molded with no aging) shall be installed in a life test cylinder in accordance with figure 5, as used in the cycling tests of aged rings and cycled under identical conditions of pressure, temperature, stroke and speed of cycling, standby, and total number of cycles, except that the O-ring adapters shall be V-grooves as noted in figure 5. All test data shall be recorded.

4.5.5.2.1 Leakage of the new rings shall not exceed the rate allowed under endurance cycling of aged packings. The leakage shall be recorded.

4.5.5.2.2 The right is reserved by the Services to conduct cycling tests on air-aged rings in rectangular grooves and on oil-aged rings in V-grooves if additional data is considered necessary by the Services to evaluate the manufacturer's product.

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For "V" Ring packing AN6225 Dash no.	W Inch	R Inch	B Inch	B1 Inch
1 to 7 inclusive	.1875	.0625	.093	.073
8 to 24 inclusive	.2500	.0625	.093	.073
25 to 35 inclusive	.3125	.1093	.150	.130
36 to 47 inclusive	.3750	.1250	.166	.146
48 to 55 inclusive	.4375	.1563	.207	.187
56 to 80 inclusive	.5000	.1563	.207	.187

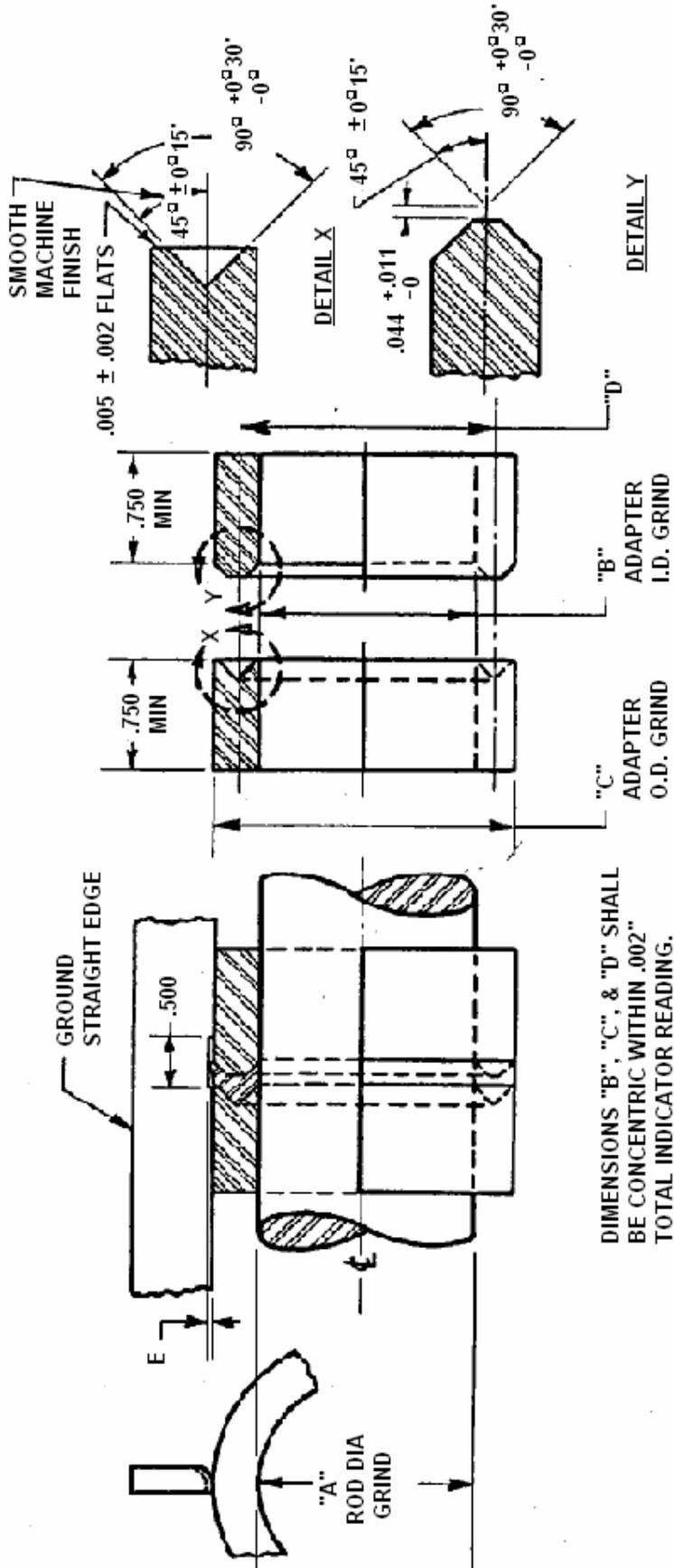
Examination characteristics with applicable packing in templates.

1. Smallest permissible stack height indicated when surfaces X and Z of low tolerance templates come together and angle surfaces of both templates and packing ring are in contact within allowable angularity limits of AN6225.
2. When angle surfaces of both template and packing ring are in contact, but surfaces X and Z are apart, revert to high limit tolerance template.
3. Highest permissible stack height indicated when surfaces X and Z of high tolerance templates come together and angle surfaces of both templates and packing ring are in contact within allowable angularity limits of AN6225.

NOTE: Care should be taken to not injure sealing lips of packing with templates.

Dimensions in inches. Template tolerances, unless otherwise specified, ± 0.001 , angles $\pm 1/2^\circ$.

Figure 1. Templates for checking cross section of V-ring and stack height dimensions.



1. V-ring shall slide on mandrel with no light visible around I.D.
2. V-ring shall be seated into female adapter with no distortion of lips (lack of concentricity between V-ring and female adapter shall not be apparent.)
3. With both male and female adapters pressed against V-ring, by light hand pressure, on the mandrel, a positive projection of the lip shall be apparent above the OD of the male and female adapters as shown by a straight edge. This shall be true over entire 360° of periphery.

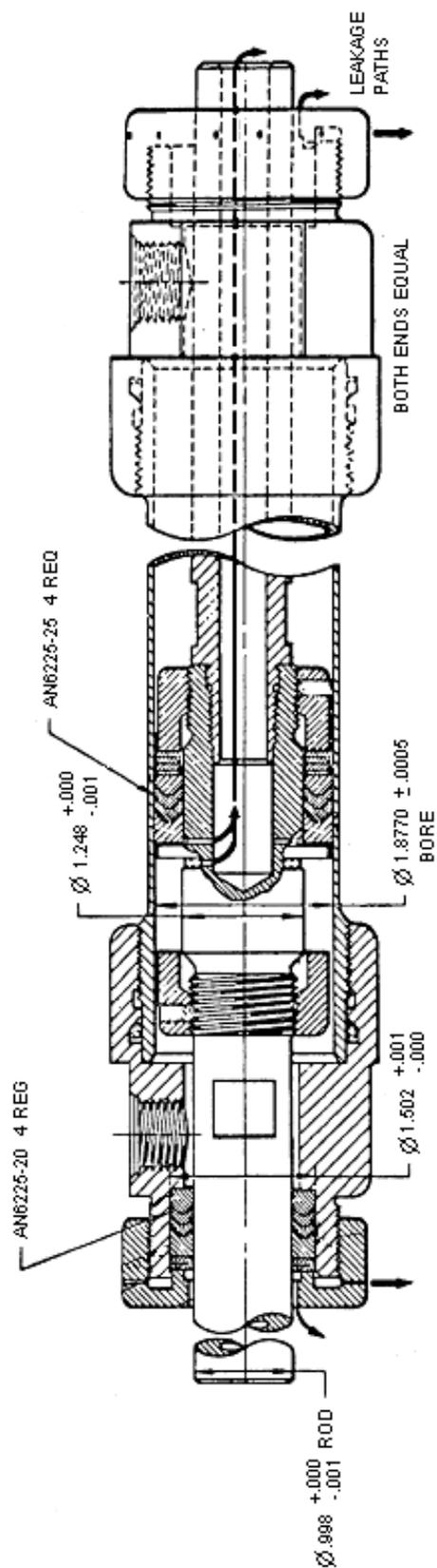
Figure 2 (sheet 1 of 2). Tools and method for inspection of V-ring diameter.

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AN6225 V-ring Dash no.	A +.0000 -.0005	B +.0005 -.0000	C ±.00025	D ±.0005	E Min. Ref.	AN6225 V-ring Dash no.	A +.0000 -.0005	B +.0005 -.0000	C ±.00025	D ±.0005	E Min. Ref.
1	.121	.1215	.504	.3125	.0015	41	3.120	3.121	3.880	3.500	.0035
2	.1835	.184	.5665	.375	.0015	42	3.245	3.246	4.005	3.625	.0035
3	.246	.2465	.629	.4375	.0015	43	3.370	3.371	4.130	3.750	.0035
4	.3065	.309	.6915	.500	.0015	44	3.495	3.496	4.255	3.875	.0035
5	.371	.3715	.754	.5625	.0015	45	3.620	3.621	4.380	4.000	.0035
6	.4335	.434	.8165	.625	.0015	46	3.745	3.746	4.505	4.125	.0035
7	.496	.4965	.879	.6875	.0015	47	3.870	3.871	4.630	4.250	.0035
8	.246	.2465	.754	.500	.0015	48	3.870	3.871	4.755	4.3125	.0065
9	.3085	.309	.8165	.5625	.0015	49	3.995	3.996	4.880	4.4375	.0065
10	.371	.3715	.879	.625	.0015	50	4.245	4.246	5.130	4.6875	.0065
11	.4335	.434	.9415	.6875	.0015	51	4.495	4.496	5.380	4.9375	.0065
12	.496	.4965	1.004	.750	.0015	52	4.745	4.746	5.630	5.1875	.0065
13	.5585	.559	1.0665	.8125	.0015	53	4.995	4.996	5.880	5.4375	.0065
14	.621	.6215	1.129	.875	.0015	54	5.245	5.246	6.130	5.6875	.0065
15	.6835	.684	1.1915	.9375	.0015	55	5.495	5.496	6.380	5.9375	.0065
16	.746	.7465	1.254	1.000	.0015	56	5.495	5.496	6.505	6.000	.0065
17	.8085	.809	1.3165	1.0625	.0015	57	5.745	5.746	6.755	6.250	.0065
18	.871	.8715	1.379	1.125	.0015	58	5.995	5.996	7.005	6.500	.0065
19	.9335	.934	1.4415	1.875	.0015	59	6.245	6.246	7.255	6.750	.0065
20	.996	.9965	1.504	1.250	.0015	60	6.495	6.496	7.505	7.000	.0065
21	1.0585	1.059	1.5665	1.3125	.0015	61	6.745	6.746	7.755	7.250	.0065
22	1.121	1.1215	1.629	1.375	.0015	62	6.995	6.996	8.005	7.500	.0065
23	1.1835	1.184	1.6915	1.4375	.0015	63	7.245	7.246	8.255	7.750	.0065
24	1.246	1.2465	1.754	1.500	.0015	64	7.495	7.496	8.505	8.000	.0065
25	1.246	1.2465	1.879	1.5625	.003	65	7.745	7.746	8.755	8.250	.0065
26	1.371	1.3715	2.004	1.6875	.003	66	7.995	7.996	9.005	8.500	.0065
27	1.496	1.4965	2.179	1.8125	.003	67	8.495	8.496	9.505	9.000	.0065
28	1.621	1.6215	2.254	1.9375	.003	68	8.995	8.996	10.005	9.500	.0065
29	1.746	1.7465	2.379	2.0625	.003	69	9.495	9.496	10.505	10.000	.0065
30	1.871	1.8715	2.504	2.1875	.003	70	9.995	9.996	11.005	10.500	.0065
31	1.996	1.9965	2.629	2.3125	.003	71	10.495	10.496	11.505	11.000	.0065
32	2.121	2.1215	2.754	2.4375	.003	72	10.995	10.996	12.005	11.500	.0065
33	2.246	2.2465	2.879	2.5625	.003	73	11.495	11.496	12.505	12.000	.0065
34	2.371	2.3715	3.004	2.6875	.003	74	11.995	11.996	13.005	12.500	.0065
35	2.496	2.4965	3.129	2.8125	.003	75	12.495	12.496	13.505	13.000	.0065
36	2.496	2.4965	3.254	2.875	.0035	76	12.995	12.996	14.005	13.500	.0065
37	2.620	2.6205	3.380	3.000	.0035	77	13.495	13.496	14.505	14.000	.0065
38	2.745	2.7455	3.505	3.125	.0035	78	13.995	13.996	15.005	14.500	.0065
39	2.870	2.5705	3.630	3.250	.0035	79	14.495	14.496	15.505	15.000	.0065
40	2.999	2.9955	3.755	3.375	.0035	80	14.995	14.996	16.005	15.500	.0065

Figure 2 (sheet 2 of 2). Tools and method for inspection of V-ring diameter.

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NOTES:

CYLINDER BARREL

MATERIAL: STEEL - SAE-AMS-S-6758 (4130).

HEAT TREAT 125,000 P.S.I. TENSILE STRENGTH

BORE GROUND AND HONED TO 5 TO 10 MICRO-INCH (RHR).

FINISH IN ACCORDANCE WITH MIL-STD-10.

NO PLATING.

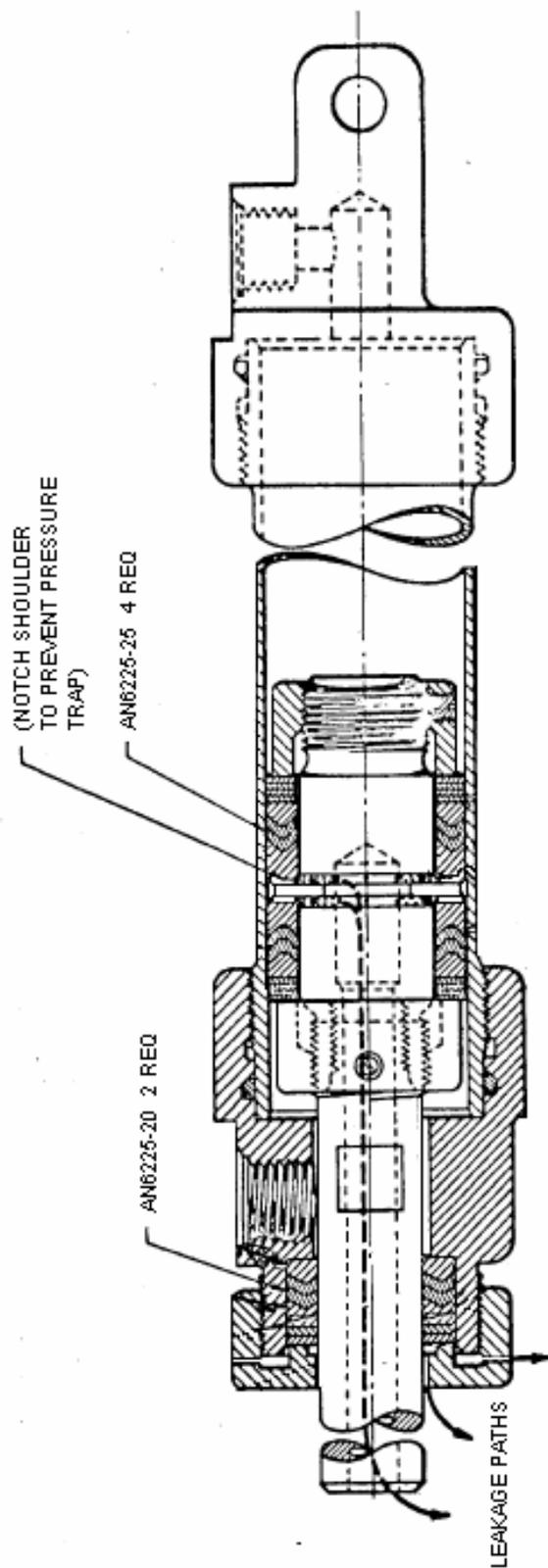
WALL THICKNESS SHALL BE SUCH AS TO BURST AT 6,000 P.S.I. MAX.

ROD FINISH: GRIND AND LAP TO 5 TO 10 MICRO-INCH (RHR).

CYLINDER IN ACCORDANCE WITH SPECIFICATIONS MIL-PRF-5503 AND MIL-G-5514.

Figure 3. Performance (aging, heat and cold) test cylinder

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NOTES:

CYLINDER IN ACCORDANCE WITH SPECIFICATIONS MIL-PRF-5503 AND MIL-G-5514.

CYLINDER BARREL

MATERIAL: STEEL - SAE-AMS-S-6758 (4130).

HEAT TREAT 125,000 P.S.I. TENSILE. STRENGTH.

BORE GROUND AND HONED TO 5 TO 10 MICRO-INCH (RHR).

FINISH: CHROME PLATING MAY BE USED.

WALL THICKNESS SHALL BE SUCH AS TO BURST AT 6,000 P.S.I MAX., INTERNAL PRESSURE.

ROD FINISH: GRIND AND LAP TO 5 TO 10 MICRO-INCH (RHR). - CHROME PLATE.

ALL RETAILS OF CYLINDER ASSEMBLY AND DETAIL PARTS NOT SHOWN HEREON SEE FIG. 3.

Figure 5. Endurance (aged and unaged packing) test cylinder.

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5. PACKAGING

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

6. NOTES

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

6.1 Intended use. This specification covers packings and gaskets intended for use at a temperature range of -65° to 160°F (-54° to 71°C) in hydraulic systems in accordance with Specification MIL-G-5514, SAE-AS5440 and shock absorbers. These rings should not be used in conjunction with any hydraulic fluid other than that conforming to Specification MIL-PRF-5606, unless otherwise specified by the procuring activity.

6.1.1 V-ring, class A packings, are intended for use in shock absorber struts, actuating cylinders, valves, and in all parts of hydraulic mechanisms with operating pressure of from 0 to 1,500 psi (0 to 10.34Mpa).

6.2 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) AN part number (see AN6225).
- (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.

Low flexibility
packing
V-ring

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6.5 Shelf-life. This specification covers items where the assignment of a Federal shelf-life code is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order, and should include, as a minimum, shelf-life code, shelf-life package markings in accordance with MIL-STD-129 or FED-STD-123, preparation of a material quality storage standard for type II (extendible) shelf-life items, and a minimum of 85 percent shelf-life remaining at time of receipt by the Government. These and other requirements, if necessary, are in DoD 4140.27-M, *Shelf-life Management Manual*. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for Shelf-life management may be obtained from DoD 4140.27-M, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points that manage the item and (2) the DoD Services and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life program can be contacted through the DoD Shelf-Life Management website: <https://www.shelflife.hq.dla.mil/>.

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

Custodian:

Army - MI
Navy - AS
Air Force - 11

Preparing activity:

DLA - IS

(Project 5330-2008-003)

Review activities:

Army - AT, AV, CR4, EA
Navy - CG, MC, SA, SH
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>.