



Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE RECOMMENDED PRACTICE

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PERFORMANCE QUALIFICATION TESTING FOR BACK-UP RINGS AND SPECIAL SEALING DEVICES

1. SCOPE

This document covers back-up rings and special sealing devices intended for use at temperatures of -65 F to +275 F and at pressures up to 4000 psi in fluid system components used in conjunction with packings and gaskets using MIL-H-5606 fluid or other media, as applicable. Meeting performance requirements is the major object of this document.

2. APPLICABLE DOCUMENTS

- 2.1 Government Documents - The following documents, of the issue in effect on the date of invitation for bids, form a part of this document to the extent specified herein. When the requirements of this document conflict with those of any specification, standard, or other document mentioned herein, the requirements of this document shall govern.

2.1.1 Specifications

Military

MIL-P-5514	Packings: Installation and Gland Design, Hydraulic, General Specification for
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft and Ordnance
MIL-H-6083	Hydraulic Fluid, Petroleum Base, Preservative
MIL-S-18729	Steel Plate, Sheet, and Strip, Alloy 4130, Aircraft Quality

Federal

QQ-A-250	Aluminum Alloy Plate and Sheet, General Specification for
QQ-B-626	Brass, Leaded and Nonleaded, Rod, Shapes, Forgings, and Flat Products with Finished Edges (Bar & Strip)
QQ-B-750	Bronze, Phosphor; Bar, Plate, Rod, Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections

2.1.2 Standards

Military

MIL-STD-10	Surface Roughness, Waviness and Lay
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MS28773	Retainer, Packing Back-up, Tetrafluoroethylene, Straight Thread Tube Fitting Boss
MS28774	Retainer, Packing Back-up, Single Turn, Tetrafluoroethylene
MS28782	Retainer, Packing Back-up, Teflon
MS28783	Ring, Gasket, Back-up, Teflon

SAE Technical Board rules provide that: "All technical reports, including standards, approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report, in formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

Federal

Fed. Test Method Std 791 Lubricants, Liquid Fuels, and Related Products; Methods of Testing

2.2 Other Publications

ASTM-D-91 Method of Test for Precipitation Number of Lubricating Oils

3. REQUIREMENTS

- 3.1 Qualification - The sealing devices furnished under this document shall be products identical to samples which have passed the qualification tests specified herein.
- 3.2 Materials - No specific material or configuration is required by this document so long as it meets the test requirements specified herein and material is identified in terms of physical properties by the manufacturer at the time of qualification for the specific sealing device. No changes in design or material are permitted without requalification, once performance requirements delineated herein have been met.
- 3.3 Shape and Dimensions - The general configuration and dimensions of the sealing devices which function in grooves as specified in MIL-P-5514, and special sealing devices requiring groove sizes and shapes other than MIL-P-5514 may be qualified under this document.
- 3.4 Compatibility - The sealing devices shall be suitable for use in fluid systems and shall have no adverse effect on the properties of the fluid, packings or metal contained within the system, nor shall the fluids have an adverse effect on the sealing devices when tested in conformance to para. 5. Where the sealing devices are composed of more than one component, as in back-up rings with O-rings, all components shall meet the compatibility requirements specified.
- 3.5 Temperature - The sealing devices shall operate satisfactorily at fluid temperatures ranging from -65 F to +275 F, unless otherwise specified.
- 3.6 Pressure - The sealing devices shall operate satisfactorily at continuous or pulsating operating pressures as required by design, ranging from 0 to 4000 psi. Sealing devices qualified to this document shall be identified as to the pressure level at which they were qualified.
- 3.7 Performance - The sealing devices, when tested with MIL-H-5606 or other designated fluid under simulated operating conditions as specified in para. 5, shall meet the conditions stated therein.
- 3.8 Physical Properties - The physical properties of the components of the sealing device shall be uniform throughout. The selection of materials from which the sealing devices are to be made, and the specific properties required of those materials are left to the discretion of the manufacturer to effect control of reproducibility prior to qualification. When the manufacturer submits his product for qualification he shall declare, in writing, the material he has selected, and the material properties, values and tolerances which both his qualification and production lots will meet. He shall further designate which tests will be conducted on each lot. The qualifying agency reserves the right to withhold qualification if, in its judgment, adequate tests, material selection, material definition and material quality assurance definition is not provided. If a source desires to make any change in his materials or their properties outside his disclosed definition, he shall request requalification of the changed product.
- 3.8.1 The disclosure of material properties shall include at least tensile strength, elongation, stiffness, specific gravity, thermal expansion, corrosion resistance and dimensional stability, unless specifically excluded by the fabricator with a statement of explanation. The design agency and/or the sealing device fabricator may supply to the involved government agency or other procuring activity, sufficient information to convince them that the dimensional instability is not detrimental to performance by virtue of design or compatibility with test fluid media.

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection Responsibility - Unless otherwise specified herein, the supplier is responsible for the performance of all inspection requirements prior to submission for inspection and acceptance. The supplier may utilize his own facilities or any commercial laboratory acceptable to the Government or other procuring activity. Inspection records of the examinations and tests shall be maintained complete and available to the government or other procuring activity as specified in the contract or order.

4.2 Classification of Tests - The inspection and testing of sealing devices shall be classified as follows:

- a. Qualification tests (4.4).
- b. Inspection test (6).

4.3 Test Conditions and Media - Test conditions as specified in this document shall be used.

4.4 Qualification Tests - The qualification tests of the sealing devices consist of the following:

- a. Performance (5.1) - Required
 - b. Compatibility (5.2).
 - c. Corrosion (5.3).
 - d. Dimensional stability (5.4).
 - e. Tensile strength (6.4).
 - f. Elongation (6.4).
 - g. Stiffness (6.4).
 - h. Specific Gravity (6.4).
- } AS REQUIRED

Upon qualification of sealing devices per this document the physical properties tests will act as a quality control standard for checking subsequent manufactured seals.

4.4.1 Qualification Samples - The qualification test samples shall consist of sealing devices conforming to the dimensional requirements corresponding to rod and bore sizes of MIL-P-5514, in the sizes and quantities listed below. If external or internal sealing devices call for different parts, or if special groove sizes are necessary, the requirements of para. 5 shall govern.

<u>Cross Section</u> (Inch)	<u>Size</u> (Dash No.) ARP568	<u>Quantity</u>
1/16	-010	8 I. D. installation
1/16	-012	10 O. D. installation
1/8	-210	8 I. D. installation
1/8	-222	14 O. D. installation
1/4	-429	18 I. D. & O. D. installation

5. QUALIFICATION TESTS - METHODS

- 5.1 Performance Test - Sealing devices which are submitted for qualification to this document shall be designated by the submitting agency according to each section of para. 5.1.1 below. It is the intent of these qualification tests to evaluate the performance of sealing devices which may include one or more components. Components of sealing devices which meet a current MS drawing or MIL specification will not require further determination of material properties as required by para. 4.4 (b through h), or further declaration of dimensional values and tolerances.

5.1.1 Designated Performance Capability

- a. Maximum service pressure capability.
- b. Dynamic or static performance.
- c. Pressure reversal capability.

Sealing devices which are designated by the submitting agency to have pressure reversal capability shall be required to pass Performance Tests I and II. All others shall be required to pass Performance Test I.

- 5.1.2 Performance Test I - In order to determine the performance of sealing devices, test units shall be prepared and tests performed as specified below. The gland sizes required by para. 4.4.1 shall be used in the dash numbers indicated for 1/16, 1/8 or 1/4 in. size, as required. Special gland sizes, as necessary to accommodate sealing devices which will not fit MIL-P-5514 grooves, are allowed, if required groove sizes and tolerances are specified by the submitting agency.

A complete performance test shall be made of each of the sizes required by para. 4.4.1, unless the submitting agency excludes one or more size combinations with a statement of explanation which is satisfactory to the procuring activity.

- 5.1.2.1 Test Actuators - Test actuators shall be prepared according to Fig. 1. The seal assembly dimensions of the piston rod and piston head sealing devices shall be controlled so that the conditions listed below are met:

- a. Diametral clearance between the piston head and cylinder bore, and the piston rod and gland shall be the maximum permitted by MIL-P-5514, with a tolerance of ± 0.0005 inches.
- b. Seal groove dimensions shall be selected at tolerance extremes which will impose the most severe test of the sealing device's performance capability.
- c. Surface finishes shall conform to the requirements specified in MIL-P-5514, but shall not be smoother than 8 microinches RHR, unless otherwise specified.

- 5.1.2.2 Test Setup - The test setup shall be capable of imposing the design load requirement. The test fixture shall be capable of operation at 4000 psi. The actuator piston rod shall be connected to a bellcrank which shall travel through an arc of at least 90 deg during each long stroke cycle.

- 5.1.2.3 Cyclic Actuation - The cyclic actuation of the test unit shall comprise a stroke, as shown in Table A, at a frequency of 30 ± 5 cycles per minute, on which is superimposed a dither of ± 0.06 (0.12 in. total amplitude) at a frequency of 600 ± 100 cycles per minute. The cyclic inputs may be sinusoidal in nature.

Table A

<u>Cross Section (Inch)</u>	<u>Stroke (Inches)</u>	<u>Total Amplitude (Inches)</u>
1/16	+ 1	2
1/8	+ 2	4
1/4	+ 5	10