AEROSPACE MATERIAL SPECIFICATION

AMS-P-5510™	REV. B

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Superseding AMS-P-5510A

O-Ring, Preformed, Straight Thread Tube Fitting Boss, Type I Hydraulic (-65 to 160 °F)

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

STABILIZED NOTICE

AMS-P-5510B has been declared “STABILIZED” by SAE AMS Committee CE Elastomers and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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NOTICE

The initial SAE publication of this document was taken directly from U.S. Military Standard MIL-P-5510C. This SAE Standard retains the same part numbers established by the original military document. Any requirements associated with Qualified Products Lists (QPL) may continue to be mandatory for DoD contracts.

1. SCOPE

1.1 Form

This specification covers requirements for the material, design, testing and packaging of straight thread tube fitting boss O-rings. O-rings covered by this specification are acrylonitrile-butadiene rubber.

1.2 Application

O-rings covered by this specification are intended for use in aircraft Type I hydraulic systems (-65 to 160 °F) to seal standard fitting of the AS4395 and AS5202 bosses as indicated in MS21344.

1.3 Safety-Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS2817 Packaging and Identification, Preformed O-rings

AMS6350 Steel Plate, Sheet, and Strip, Alloy 4130 Aircraft Quality

AMS-QQ-A-250/4 Aluminum Alloy 2024, Plate and Sheet

AMS-QQ-A-250/11 Aluminum Alloy 6061, Plate and Sheet

AMS-QQ-A-250/12 Aluminum Alloy 7075, Plate and Sheet

AMS-QQ-S-763 Steel Bar, Shapes, and Forgings - Corrosion Resisting (440C Stainless Steel)

AS28778 O-ring, Preformed, Straight Thread Tube Fitting Boss

AS33566 Fittings, Installation of Flareless Tube, Straight-Threaded Connectors

AS4395 Fitting End, Standard Dimensions for Flared Tube Connection and Gasket Seal

AS5202 Bosses Fluid Connection, Internal Straight Thread

2.2 ASQ Publications

Available from the American Society of Quality (ASQ), ASQ Distribution Center, 5131 S. Third Street, Milwaukee, Wisconsin 53207-6028, Tel: 800-248-1946, www.asq.org.

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

2.3 ISO Publications

Available from the International Organization for Standardization (ISO), CME Postale 56, CH-1211 Genève, Switzerland or www.iso.org.

ISO 3601-3 Fluid Power Systems-O-rings-Part 3: Quality Acceptance Criteria

2.4 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, http://assist.daps.dla.mil/quicksearch/.

MIL-PRF-5606 Hydraulic Fluid, Petroleum Base, Aircraft and Ordnance

MIL-PRF-6083 Hydraulic Fluid Petroleum Base, Preservative

MS21344 Fittings-Installation of Flared Tube, Straight Thread Connectors Design Standard for

2.5 ASME Publications

Available from ASME, Three Park Avenue, New York, NY 10016-5990, Tel: 800-843-2763, www.asme.org.

ASME B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

2.6 PRI Publications

Available from Performance Review Institue (PRI), 161 Thorn Hill Road, Warrrendale, PA 15086-7257, Tel: 724-772-1616, www.pri-network.org.

PD2000 Procedures for an Industry Qualified Product Management Process

PD2102 Aerospace Quality Assurance, Product Standards, Qualification Procedure, Elastomeric Seal

2.7 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A 484 Steel Bar, Corrosion Resistant Free Machining (303 Stainless Steel)

ASTM D 1414 Rubber O-Rings

ASTM D 2240 Indentation Hardness of Rubber and Plastic by Means of a Durometer

3. REQUIREMENTS

3.1 Qualification

Products sold to this specification shall be listed on the PRI qualified products list, (QPL). The qualified products list shall be in accordance with PD2000 (see 5.3).

3.1.1 Qualification shall be reapproved every three years in accordance with PD2000, PD2102 and the instructions from the Performance Review Institute. Testing shall be in accordance with 4.2.2.

3.1.2 General

The material used shall be suitable as a compression-type seal on straight-threaded, flared-tube connection fittings assembled in AS4395 and AS5202 bosses in accordance with MS21344 or flareless fittings with AS4375 ends used with MIL-PRF-5606 hydraulic fluid in hydraulic systems or with air in pneumatic systems. The material shall contain no substances which, when in contact with surrounding components, will adversely affect the components or O-rings as indicated by tests described in Section 3.2. The material shall be homogeneous to ensure consistent swell, strength, and hardness characteristics throughout the entire batch. Natural rubber shall not be used.

3.1.3 Tolerances

The maximum permissible variations in original physical properties during actual production from the values established in the Government test report for qualification testing shall be as specified in Table 2. In no case shall the production test values be less than the minimum or exceed the maximum specified in Table 1.

3.1.4 Shape and Dimensions

Detail shapes, dimensions and tolerances, and markings shall conform to AS28778 and the requirements given herein.

3.2 Physical Properties

Properties of the materials shall conform to the requirements specified in Table 1.

TABLE 1 - PHYSICAL PROPERTY REQUIREMENTS

Paragraph	Property	Requirement [2]	Test Method
3.2.1	Specific Gravity/ Relative Density	1.25 - 1.45	ASTM D1414
3.2.2	Hardness[1], Durometer A	85 to 95	ASTM D2240
3.2.3	Tensile Strength, psi	1450 min.	ASTM D1414
3.2.4	Ultimate elongation, percent	80 min.	ASTM D1414
3.2.5	Tensile stress at 50 percent elongation,psi	500 min.	ASTM D1414
3.2.6	Temperature retraction, TR-10	-45 °F (-43 °C) max	ASTM D1414
3.2.7	Corrosion and adhesion	none	See 3.2.11
3.2.8	Dry Heat Resistance:		ASTM D1414 158°F ± 1.8 (70°C ± 1) 168 hours ± 0.5
3.2.8.1	Hardness change, points [1]	0 to 5	
3.2.8.2	Tensile strength change, percent	-10 max.	
3.2.8.3	Elongation change, percent	-15 max.	
3.2.9	Compression set Percent of original deflection	35 max.	ASTM D1414 158°F ± 1.8 (70°C ± 1) 168 hours ± 0.5
3.2.10	Oil Resistance:		ASTM D1414 In MIL-PRF-5606 158°F ± 1.8 (70°C ± 1) 168 hours ± 0.5
3.2.10.1	Hardness change, points [1]	-5 to 5	
3.2.10.2	Tensile strength change, percent	-15 max.	
3.2.10.3	Elongation change, percent	-20 max.	
3.2.10.4	Temperature retraction, TR-10	-39°F (-39.5 °C) max.	
3.2.10.5	Compression set Percent of original deflection	25 max.	
3.2.10.6	Volume change, percent	1 to 8	

NOTES:

1. Hardness tests before and after aging shall be made on one ASTM hardness disc 0.25 inch (6 mm) thick by 1.0 inch (25.4 mm) diameter. The specimen shall not be composed of plies of thinner pieces. Hardness shall not be determined from actual O-rings.

2. All tests except hardness Durometer A to be conducted on MS28778-16 O-rings.

3.2.11 Corrosion and Adhesion Testing Method

3.2.11.1 MS28778-16 O-rings, two for each plate, shall be prepared for corrosion testing by inserting sufficient quantities of the O-rings in a desiccator or similar humidity chamber maintained at 92 percent minimum relative humidity and 77 °F ± 3.6 (25 °C ± 2) for at least 72 hours.

3.2.11.2 Plates of the metals listed below shall be polished to a surface roughness of 4 to 16 RHR in accordance with AMSE B46.1. The edges shall also be polished to reduce the formation of edge corrosion. The plates shall be washed with toluene, aliphatic naphtha, or similar degreasing agent that will produce a clean dry surface free from film. The metals used shall be as follows:

AMS-QQ-A-250/4 - Aluminum Alloy 2024
AMS-QQ-A-250/11 - Aluminum Alloy 6061
AMS-QQ-A-250/12 - Aluminum Alloy 7075
AMS-QQ-S-763 - 440C Stainless Steel
ASTM A484 - 303 Stainless Steel (Free machining)
AMS-6350- 4130 Steel, Aircraft Quality

3.2.11.3 The humidified O-rings and metallic plates shall be immersed in MIL-PRF-6083 fluid and drained to the drip point. The O-rings and plates shall then be so laid together in a stack so that at least two O-rings 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 77 °F ± 3.6 (25 °C ± 2). This relative humidity may be produced by the use of a salt of sufficient concentration in solution with distilled water. Time of humidity exposure shall be 14 days. No more than 15 minutes should elapse between the time the samples are removed from the prehumidifying chamber and placed in the stacked condition in the second humidity chamber.

3.2.11.4 At the termination of this test, the procedures outlined below shall be followed:

3.2.11.4.1 The surface of the plates that 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.'

3.2.11.4.2 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 from the O-rings, a microscope of approximately 10 to 15-power magnification shall be used to determine the actual condition.

3.3 Maximum permissible production variation requirements specified in Table 2.

TABLE 2 - MAXIMUM PERMISSIBLE PRODUCTION VARIATIONS

Paragraph	Property	Maximum Permissible Production Variation
3.2.1	Specific Gravity/ Relative Density	±0.02
3.2.3	Tensile Strength, pct.	±15
3.2.4	Elongation, pct.	±20
3.2.5	Tensile Stress at 50% elongation, pct	±20
3.2.7	Corrosion and Adhesion	None
3.2.6	Temperature Retraction, TR-10	±3.6°F (±2°C)
3.2.10.6	Volume Change, percent	±2(1)

NOTE 1: Swell determined from Qualification Test Value ± 2, but must not shrink.

3.4 Identification and Packaging

Packaging shall be in accordance with AMS2817 with the exception that, if requested by contract, each package shall bear the following identification of a recognizable size:

National Stock Number

If required by the purchaser, the manufacturer shall individually package all the O-rings.

3.5 Workmanship and finish shall be in accordance with the best commercial practice.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The manufacturer of the product shall be responsible for performance of all required tests. Purchaser reserves the right to sample and perform any testing deemed necessary to ensure that the product conforms to the AMS requirements.

The supplier is responsible for ensuring 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. In the event of conflict, this specification shall govern. Inspection records shall be kept complete and available to the procuring activity at all times.

4.1.1 Manufacturer

Shall be on the current PRI Qualified Manufacturer's List (QML).

4.2 Classification of Tests

The inspection and testing of AS28778 O-rings shall be classified as follows:

4.2.1 Qualification Tests

4.2.1.1 Shall be in accordance with PD 2000 and PD 2102. Verification tests shall consist of tests listed in Table 3. Testing for requalifications shall be all technical requirements (no verification tests are required).

4.2.1.2 Qualification test samples include 50 MS28778-16 O-rings and 3 ASTM Hardness Discs.

4.2.1.3 The hardness discs shall have the same compounding and equivalent cure as the accompanying O-rings, and the O-rings shall represent the manufacturer’s production product, particularly with respect to compound, processing, mold design, molding techniques, and finish.

4.2.2 Sampling and Testing

The qualification tests shall consist of all the tests specified in Table 1.

4.3 Acceptance Tests

Sampling for quality conformance inspection shall be in accordance with ANSI/ASQ Z1.4, except where otherwise indicated herein. Acceptance tests are required for all production batches of material.

TABLE 3- BATCH ACCEPTANCE TESTS

Paragraph	Requirement
3.2.1	Specific Gravity
3.2.2	Hardness
3.2.3	Tensile Strength
3.2.4	Ultimate Elongation
3.2.5	Tensile Stress

4.3.1 A lot shall be a quantity of one size of product processed and packaged as one production entity from a single batch.

4.3.2 A batch shall be the quantity of material compounded on a mill or mixer at one time. Excluded from the definition is mixing of batches of previously compounded material.

4.3.3 Acceptance Test Samples

The test samples shall be MS28778-16 O-rings. Hardness discs shall be used for hardness determinations.

4.3.4 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 (AQLs) set forth herein. The lot size, for the purpose of determining the sample size in accordance with ANSI/ASQ Z1.4, shall be expressed in units of O-rings.

4.3.4.1 Examination for Defects in Appearance and Workmanship

The examination shall be in accordance with ISO 3601-3 Grade CS. The sample size shall be in accordance with inspection level II of ANSI/ASQ Z1.4 and the AQL related to percent defective shall be 1.0 except that the acceptance number shall be zero.

4.3.4.2 Examination for Dimensional Defects

The examination shall be made to the tolerances specified in AS28778. The sample size shall be in accordance with inspection level II of ANSI/ASQ Z1.4 and the AQL related to percent defective shall be 1.0 except that the acceptance number shall be zero.

4.3.4.3 Examination for Defects in Preparation for Delivery

An examination shall be made to determine that the packaging, O-ring, 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.