AEROSPACE MATERIAL SPECIFICATION

AMS7361™	REV. A
Issued 2021-07 Issued 2022-10 Superseding AMS7361	

Rubber: Ethylene Propylene (EP)
Phosphate Ester Resistant
Low Temperature Tg -67 °F (-55 °C), 75 to 85 Type M Hardness
for Seals in Hydraulic Systems

RATIONALE

This standard has been revised to clarify usage in the application section (1.2), add Tg temperature capability to the title, and remove the word "if" from 3.2.4.

1. SCOPE

1.1 Form

This specification covers an ethylene propylene rubber in the form of molded rings, molded compression seals, molded O-ring cord, and molded-in-place gaskets for aeronautical and aerospace applications.

1.2 Application

This material has resistance to AS1241 Type IV Class 1 and Type V Grade A and Grade B phosphate ester fluids, but usage is not limited to such applications. This material is not intended for use in AS1241 Type IV Class 2 fluids. This material has an expected service temperature range of -75 to 250 °F (-59 to 121 °C), with excursions up to 300 °F. The expected low temperature limit is derived from an industry practice of using 15 °F (8 °C) below the temperature retraction (TR10). The service temperature range of the material is a general temperature range, but the presence of particular fluids and specific design requirements may modify this range. Each application should be considered separately. This specification is intended for use in static applications and was developed to provide an ethylene propylene rubber compound for hydraulic seals with improved low temperature performance. It has not been evaluated for dynamic applications. It is the responsibility of the user to determine that this specification is appropriate for the environments (temperature range, fluids exposure, dynamic usage, etc.) in which it is sought to be used.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS7361A/

1.3 Order of Precedence

Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained. This specification is in addition to and in no way limiting, superseding, or abrogating any contractual obligation as required by the applicable procurement document. In the event of conflict in requirements, the order of precedence shall be:

1. Procurement document or contractual agreement and all statutory and regulatory requirements (excluding this document)
2. Applicable purchaser's drawing or parts standard
3. Specification referenced on the drawing
4. This document
5. All specifications referenced in this document

1.4 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 +1 724-776-4970 (outside USA), www.sae.org.

AMS2817	Packaging and Identification, Preformed Packings
AIR851	O-Ring Tension Testing Calculations
ARP3050	Suitable Test Sizes for O-Ring Specifications
AS568	Aerospace Size Standard for O-Rings
AS1241	Fire Resistant Phosphate Ester Hydraulic Fluid for Aircraft
AS5316	Storage of Elastomer Seals and Seal Assemblies Which Include an Elastomer Element Prior to Hardware Assembly
AS5752	Visual Inspection Standard for Elastomeric Sealing Elements Other than O-Rings
AS6414	Manufacturing Processing Requirements for Molded Elastomer Components Used in Aerospace Applications
AS7982	Static Seal Test Fixture and Procedure

2.2 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 D297 Standard Test Methods for Rubber Products - Chemical Analysis

ASTM D395 Standard Test Method for Rubber Property - Compression Set Method B

ASTM D471 Standard Test Method for Rubber Property - Effects of Liquids

ASTM D573 Standard Test Method for Rubber - Deterioration in an Air Oven

ASTM D1329 Standard Test Method for Evaluating Rubber Property - Retraction at Lower Temperatures (TR)

ASTM D1414 Standard Test Methods for Rubber O-Rings

ASTM D2240 Standard Test Method for Rubber Property - Durometer Hardness

ASTM D3677 Standard Test Methods for Rubber - Identification by Infrared Spectrophotometry

ASTM D7426 Standard Test Method for Assignment of the DSC Procedure for Determining Tg of a Polymer or an Elastomeric Compound

ASTM E1131 Standard Test Method for Compositional Analysis by Thermogravimetry (TGA)

2.3 ISO Publications

Copies of these documents are available online at http://webstore.ansi.org/.

ISO 3601-1 Fluid Power Systems - O-Rings - Part 1: Inside Diameter, Cross Sections, Tolerances and Designation Codes

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

2.4 PRI Publications

Available from Performance Review Institute (PRI), 161 Thorn Hill Road, Warrendale, 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

3. TECHNICAL REQUIREMENTS

3.1 Compound

Shall be prepared from ingredients as shall be necessary to achieve the requirements detailed in this standard and shall be a compound, based on the polymer specified in 1.1, shall be peroxide cured, and shall meet the requirements of 3.2. Reprocessed vulcanized material is not acceptable.

3.2 Qualification Properties

The material as processed by the molder in the form as defined in Table 1 (test sample) shall conform to the requirements shown in Table 1; calculations of tensile strength and elongation may be made in accordance with AIR851.

Material shall be tested on size standard AS568-214 O-rings to determine the qualification properties.

Table 1 - Qualification properties

Paragraph	Property	Test Sample	Requirements	Test Method
3.2.1	**As Received**			
3.2.1.1	Hardness, Durometer Type "M"	AS568-214 O-rings	80 ± 5	ASTM D1414 (D2240)
3.2.1.2	Tensile Strength, Minimum	AS568-214 O-rings	1350 psi (9.6 MPa)	ASTM D1414
3.2.1.3	Elongation, Minimum	AS568-214 O-rings	125%	ASTM D1414
3.2.1.4	Specific Gravity/Relative Density	AS568-214 O-rings	Preproduction value ± 0.02	ASTM D1414 (D297) Hydrostatic Method
3.2.2	Glass Transition (Tg) by Midpoint, Maximum	AS568-214 O-rings	-67 °F (-55 °C)	ASTM D7426
3.2.3	Temperature Retraction Test [TR-10], Maximum	AS568-214 O-rings	-60 °F (-51 °C)	ASTM D1414 (D1329), 75% Elongation
3.2.4	Compression Set. Percent of Original Deflection, Maximum O-Ring Cross Sectional Thickness 0.064 to 0.110 Inch over 0.110 Inch	O-ring	 40% 30%	ASTM D1414 (D395, Method B) Temperature: 250 °F ± 4 °F (121 °C ± 2 °C) Time: 22 hours ± 2 hours
3.2.5	Percent of Original Deflection, Maximum	AS568-214 O-rings	50%	ASTM D1414 (D395, Method B) Temperature: 250 °F ± 4 °F (121 °F ± 2 °C) Time: 70 hours ± 2 hours
3.2.6	**Dry Heat Resistance ASTM D573**			
3.2.6.1	Hardness, Durometer Type "M" Change	AS568-214 O-rings	0 to +10	ASTM D1414 (D573) Temperature: 300 °F ± 4 °F (149 °C ± 2 °C) Time: 70 hours ± 2 hours
3.2.6.2	Tensile Strength Change, Maximum	AS568-214 O-rings	-25%	
3.2.6.3	Tensile Elongation Change, Maximum	AS568-214 O-rings	-20%	
3.2.7	**Hydraulic Fluid Resistance, All Fluids (see Note 1) ASTM D471**			
3.2.7.1	Hardness, Durometer Type "M" Change	AS568-214 O-rings	0 to -10	ASTM D1414 (D471) Temperature: 160 °F ± 4 °F (71 °F ± 2 °C) Time: 70 hours ± 2 hours
3.2.7.2	Tensile Strength, Minimum	AS568-214 O-rings	1200 psi (8.2 MPa)	
3.2.7.3	Tensile Elongation, Minimum	AS568-214 O-rings	125%	
3.2.7.4	Volume Change	AS568-214 O-rings	+1 to +18	
3.2.7.5	Compression Set Percent of Original Deflection, Maximum	AS568-214 O-rings	20%	
3.2.8	**Hydraulic Fluid Resistance All Fluids (see Note 1) ASTM D471**			
3.2.8.1	Hardness, Durometer Type "M" Change	AS568-214 O-rings	0 to -15	ASTM D1414 (D471) Temperature: 225 °F ± 4 °F (107 °C ± 2 °C) Time: 334 hours ± 2 hours
3.2.8.2	Tensile Strength, Minimum	AS568-214 O-rings	1200 psi (8.2 MPa)	
3.2.8.3	Tensile Elongation, Minimum	AS568-214 O-rings	125%	
3.2.8.4	Volume Change	AS568-214 O-rings	+1 to +18	
3.2.9	FTIR	AS568-214 O-rings	Preproduction spectrum	ASTM D3677 (Pyrolysis Polymer Dependent)
3.2.10	TGA	AS568-214 O-rings	Preproduction curve	See 4.4.2
3.2.11	**Static Cycle Testing**			
3.2.11.1	Leakage Fixture Testing	AS568-214 O-rings	No leaks	See 4.4.1

NOTE 1: Required test fluids: All AS1241 Type IV Class 1 fluids and all AS1241 Type V Grade A and Grade B fluids that are commercially available.

3.3 Quality

All Product, as received by purchaser, shall be as specified in the SAE ASXXXX parts standard, drawing, or purchase document (see 1.3). If not specified, O-ring surface quality shall conform to ISO 3601-3 Grade S requirements. For all other compression seal geometries, the parts other than O-rings, shall meet AS5752 Type 2 requirements.

3.4 Shelf Life

Product produced from this material is shelf life controlled per AS5316 unless otherwise specified by customer procurement documents.

3.5 Dimensions and Tolerances

All dimensions and tolerances shall be as specified in the parts standard, drawing or purchase document (see 1.3). If not specified, O-rings standard sizes and tolerances shall be per AS568. The procedures outlined in Annex B of ISO 3601-1 shall be followed for dimensional inspection.

3.6 Qualification

Products sold to this specification shall be listed on the PRI qualified products list (QPL). Performance Review Institute, 161 Thorn Hill Road, Warrendale, PA 15086-7527, Tel: +1 724-772-1616, Fax: +1 724-772-1699. The online QPL is available at www.eAuditNet.com. The qualified products list shall be in accordance with PD2000 (see 8.2). If no products are listed on the PRI qualified products list, then product qualification shall be as agreed between the purchaser and manufacturer until a QPL is established.

3.6.1 The qualified product list (QPL) is a listing of manufacturers of product using a specific compound and not a listing of manufacturers of base polymers used in this specification.

3.6.2 Qualification of product shall be reapproved every 3 years in accordance with PD2000, PD2102, and the instructions from the Performance Review Institute. Testing shall be in accordance with this specification. Requalification may be done in only one AS1241 Type V Grade A or Grade B fluid, if no changes have been made to the elastomer formulation, and if the supplier retains a record of their initial qualification in all commercially available fluids.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The manufacturer of the product shall be responsible for performing all required tests. Purchaser reserves the right to sample and perform any testing deemed necessary to ensure that the product conforms to the AMS7361 requirements.

4.1.1 Manufacturer of product to this specification shall be on the current PRI qualified manufacturer's list (QML), www.eAuditNet.com.

4.2 Classification of Tests

4.2.1 Batch Testing

AS6414 defines batch testing. Testing on the same batch and state of cure are acceptable as long as the AS568-214 O-rings are cured and tested within 90 days of the manufacture of the subject lot.

Batch and the blending of compound as defined in AS6414. All incoming batches and or blended batches shall be tested per Table 2.

Table 2 - Batch test

Paragraph	Property	Test Sample	Requirements	Test Method
3.2.1	**As Received**			
3.2.1.1	Hardness, Durometer Type "M"	AS568-214 O-rings	80 ± 5	ASTM D1414 (D2240)
3.2.1.2	Tensile Strength, Minimum	AS568-214 O-rings	1350 psi (9.6 MPa)	ASTM D1414
3.2.1.3	Elongation, Minimum	AS568-214 O-rings	125%	ASTM D1414
3.2.1.4	Specific Gravity/Relative Density	AS568-214 O-rings	Preproduction value ± 0.02	ASTM D1414 (D297) Hydrostatic Method
3.2.4	Compression Set Percent of Original Deflection, Maximum	AS568-214 O-rings	30%	ASTM D1414 (D395, Method B) Temperature: 250 °F ± 4 °F (121 °F ± 2 °C) Time: 22 hours ± 2 hours
3.2.7	**Hydraulic Fluid Resistance (see Note 2) ASTM D471**			
3.2.7.4	Volume Change	AS568-214 O-rings	+1 to +18	ASTM D1414 (D471) Temperature: 160 °F ± 4 °F (71 °C ± 2 °C) Time: 70 hours ± 2 hours

NOTE 2: Required test fluid: One AS1241 Type V Grade A or Grade B fluid that is commercially available.

4.2.2 Acceptance Lot Tests

4.2.2.1 Acceptance Lot Tests for O-Rings

Requirements shown in Table 3 are acceptance lot tests and shall be performed on each lot on the O-rings being supplied.

The term "Part" in Table 3 shall be interpreted to mean the O-ring shipped. It shall be permitted to use multiple such O-rings which shall be made from the same lot and batch to perform the applicable test.

O-ring sizes that are suitable for testing (tensile and elongation) are shown in ARP3050.

If the O-ring size is such that the test cannot be performed reliably on the O-ring (or multiple O-rings of this size), then use of proxy AS568-214 O-rings cured from the same batch within 90 days of O-ring cure with the same state of cure shall be acceptable.

Table 3 - Acceptance lot test for O-rings

Paragraph	Property	Test Sample	Requirements	Test Method
3.2.1	**As Received**			
3.2.1.1	Hardness, Durometer Type "M"	Part	80 ± 5	ASTM D1414 (D2240)
3.2.1.4	Specific Gravity/Relative Density	Part	Preproduction value ± 0.02	ASTM D1414 (D297) Hydrostatic Method
3.2.4	Compression Set Percent of Original Deflection, Maximum O-Ring Cross Sectional Thickness 0.064 to 0.110 Inch over 0.110 Inch	 Part Part	 40% 30%	ASTM D1414 (D395, Method B) Temperature: 250 °F ± 4 °F (121 °C ± 2 °C) Time: 22 hours ± 2 hours
3.2.7	**Hydraulic Fluid Resistance (see Note 3) ASTM D471**			
3.2.7.4	Volume Change	Part	+1 to +18	ASTM D1414 (D471) Temperature: 160 °F ± 4 °F (71 °C ± 2 °C) Time: 70 hours ± 2 hours

NOTE 3: Required test fluid: One AS1241 Type V Grade A or Grade B fluid that is commercially available.

4.2.2.2 Acceptance Lot Tests for All Other Seal Geometries Other Than O-Rings and Plate Seals

Requirements shown in Table 4 are acceptance lot tests and shall be performed on each lot on the seals being supplied.

The term “part” in Table 4 shall be interpreted to mean the elastomer seal part being shipped. It shall be permitted to use multiple such parts which shall be made from the same lot and batch to perform the applicable test.

Table 4 - Acceptance lot test for all other seal geometries except O-rings and plate seals

Paragraph	Property	Test Sample	Requirements	Test Method
3.2.1	**As Received**			
3.2.1.4	Specific Gravity/Relative Density	Part	Preproduction value ± 0.02	ASTM D1414 (D297) Hydrostatic Method
3.2.7	**Hydraulic Fluid Resistance (see Note 4) ASTM D471**			
3.2.7.4	Volume Change	Part	+1 to +18	ASTM D1414 (D471) Temperature: 160 °F ± 4 °F (71 °C ± 2 °C) Time: 70 hours ± 2 hours

NOTE 4: Required test fluid: One AS1241 Type V Grade A or Grade B fluid that is commercially available.

4.2.2.3 Acceptance Lot Tests for Plate Seals

A plate seal is defined as an elastomer bonded to any substrate material whose primary function is to perform as a seal.

For plate seals, a suitable test plan shall be agreed upon between the user and supplier, if no specific test plan is established requirements in 4.2.1 including Table 2 tests shall be performed.

4.2.3 Lot

AS6414 as defined.

4.2.4 Random Sampling

The method shall be as specified in the parts standard, drawing or purchase document. If not specified, product shall be taken at random from each lot to perform all the required testing in Tables 3 and 4 where applicable per the part type. The number of test specimens for each requirement shall be specified in the applicable test procedure.

4.2.5 Qualification Tests

All technical requirements shall be in accordance with applicable material specification and performed prior to the initial shipment of the product to a purchaser. Any change in process or ingredients that would require requalification are listed in the AS6414 document unless otherwise specified by the purchase order, print, or design data. For initial qualification, all specimens shall be from the same production batch and lot using test samples as specified in Table 1.

4.2.5.1 Qualification Test Report

The supplier of the product shall make a qualification test report available upon request. This report shall include at a minimum: AMS number, manufacturer’s identification and product designation, batch and lot number, date of manufacture, and the results of all qualification tests.

4.3 Inspection

Dimensional and visual inspection:

4.3.1 Prior to inspection, mold flash shall be removed from the parts in such a manner that they conform to the requirements specified herein. For end of process inspection, each individual part (100%) shall be visually inspected at 1X magnification for mold flash, backrind, parting line projection, non-fills, flow lines, and other significant defects in accordance with ISO 3601-3, Grade S or AS5752 requirements. The entire part surface shall be inspected.

4.3.2 For final inspection, the sample size shall be in accordance with ANSI/ASQ Z1.4 single sampling plan inspection Level II with an AQL 1.0, except that the acceptance number shall be zero.

The sample unit shall be one part. Inspection shall be according to ISO 3601-3, Grade S or AS5752 requirements as applicable under 2X magnification. In case of disagreement, the visual inspection at 2X magnification shall govern. The entire part surface shall be manually inspected. The procedures outlined in Annex B of ISO 3601-1 shall be followed for dimensional inspection. If the purchaser requires a different sampling plan or visual inspection criteria, the manufacturer shall be informed prior to the time of order.

4.4 Test Methods

4.4.1 Static Cycle Testing

Extreme temperature and cyclic testing shall be performed per AS7982 using the test steps shown below. Leakage at each leakage check shall be insufficient to form a drop. Test fluids shall be per Note 1. Design operating pressure shall be 5000 psi. Test report per AS7982 shall be included. Temperature transition time for heating or cooling is not critical and up to the discretion of the testing house. At no time during testing should significant leakage (a steady stream) occur.

Test steps shall be as follows after bleeding air out of the fixture:

1. Leakage check: Room temperature at 5000 psi.
2. 160 °F soak for 72 hours at 50 psi.
3. Leakage check: Room temperature at 5000 psi.
4. Transition to -65 °F at 50 psi.
5. Leakage check: -65 °F at 5000 psi.
6. 100000 impulse cycles 0 to 5000 to 0 psi at 160 °F.
7. 100000 impulse cycles 0 to 5000 to 0 psi at 225 °F.
8. Transition to -65 °F at 50 psi.
9. Leakage check: -65 °F at 5000 psi.

4.4.2 Thermogravimetric Analysis

A TGA curve for the qualification sample shall be remain as part of the permanent record for the qualified compound. TGA curve shall be obtained per ASTM E1131 using a heating rate of 38 °C/min (68 °F/min) in nitrogen up to 650 °C (1202 °F). At 650 °C the gas will be switched to air or oxygen and heated at 38 °C/min (68 °F/min) to 995 °C (1823 °F). Temperature of the sample shall be maintained at 995 °C (1823 °F) for 1 minute before the test is completed. Sample composition shall be determined per ASTM E1131.

4.5 Approval

4.5.1 Unless otherwise specified by purchase order, print, or design data, when a change per AS9100, PD2102, or AS6414 occurs in ingredients, manufacturing, and/or processing reapproval to this material standard shall be required.

4.5.2 The manufacturer shall establish, for each size of seal, parameters for the process control factors which will produce seals meeting the technical requirements per 4.2.1 of this specification. Control factors for producing seals shall be per AS6414. If any change in ingredients, type of equipment for processing, or manufacturing procedures is necessary, the manufacturer shall submit for reapproval a statement of the proposed changes and, when requested, sample product. Production product made by the revised procedure shall not be shipped prior to receipt of re-approval.