



AEROSPACE MATERIAL SPECIFICATION

AMS-P-5315™**REV. C**Issued 1998-03
Revised 2022-08

Superseding AMS-P-5315B

Rubber: Acrylonitrile-Butadiene (NBR)
Fuel-Resistant
60 - 70 Type A Hardness

RATIONALE

Five-Year Review and the content restructured utilizing the new template.

1. SCOPE

1.1 Form

This specification covers an acrylonitrile-butadiene (NBR) 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

These products have been used typically at temperatures from -65 °F (-54 °C) to +180 °F (+82 °C) where resistance to fuel is required, but usage is not limited to such applications. Each application should be considered individually. It is the responsibility of the user to determine that this specification is appropriate for the environments (temperature range, fluids exposure, etc.) in which it is sought to be used.

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 (excluding this document)
2. Applicable purchaser's drawing
3. Specification referenced on the drawing
4. This document
5. All specifications referenced in this document

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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 hazardous materials and to take necessary precautionary measures to ensure 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 of Molded Elastomeric Seals and Sealing Components
AMS4027	Aluminum Alloy, Sheet and Plate, 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061; -T6 Sheet, -T651 Plate), Solution and Precipitation Heat Treated
AMS4037	Aluminum Alloy, Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024; -T3 Flat Sheet, -T351 Plate), Solution Heat Treated
AMS4045	Aluminum Alloy Sheet and Plate, 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr, 7075: (-T6 Sheet, -T651 Plate), Solution and Precipitation Heat Treated
AMS5513	Steel, Corrosion-Resistant, Sheet, Strip, and Plate, 19Cr - 9.2Ni (SAE 30304), Solution Heat Treated
AMS5630	Steel, Corrosion-Resistant, Bars, Wire, and Forgings, 17Cr - 0.52Mo (0.95 - 1.20C) (440C)
AMS6350	Steel Sheet, Strip, and Plate, 0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)
AIR851	O-Ring Tension Testing Calculations
ARP3050	Suitable Test Sizes for O-Ring Specifications
AS568	Aerospace Size Standard for O-Rings
AS5316	Storage of Elastomer Seals and Seal Assemblies Which Include an Elastomer Element Prior to Hardware Assembly
AS5752	Aerospace - Visual Inspection Standard for Elastomeric Sealing Elements Other than O-Rings
AS6414	Manufacturing Processing Requirements for Molded Elastomer Components Used in Aerospace Applications
AS29512	Hydrocarbon Fuel Resistant, Tube Fitting, O-Ring Molded from AMS-P-5315 Rubber
AS29513	Packing, Preformed, Hydrocarbon Fuel Resistant, "O" Ring

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 Rubber Products - Chemical Analysis
- ASTM D395 Rubber Property - Compression Set
- ASTM D471 Rubber Property - Effect of Liquids
- ASTM D1329 Rubber Property - Retraction at Lower Temperatures (TR Test)
- ASTM D1414 Rubber O-Rings
- ASTM D2240 Rubber Property - Durometer Hardness
- ASTM D3677 Rubber - Identification by Infrared Spectrophotometry
- ASTM E1131 Compositional Analysis by Thermogravimetry

2.3 ISO Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

- ISO 3601-1 Fluid Power Systems- O-rings - Part 1: Inside diameter, cross sections, tolerances and size identification code
- ISO 3601-3 Fluid Power Systems - O-rings - Part 3: Quality Acceptance Criteria

2.4 PRI Publications

Available from Performance Review Institute, 161 Thorn Hill Road, Warrendale, PA 15086-7527, 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

2.5 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

- MIL-PRF-6083 Hydraulic Fluid Petroleum Base, Preservative

2.6 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

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

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 an acrylonitrile-butadiene (NBR) elastomer, suitably cured to produce product meeting the requirements of 3.2. Material used shall be based on 100% virgin acrylonitrile-butadiene (NBR) elastomer. No reprocessed or non- acrylonitrile-butadiene (NBR) polymer is 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 the part standard AS29513-214 pertaining to this material specification and if no part standard exists, then testing shall be 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 "A"	BUTTON or plied platens	65 ± 5	ASTM D2240
3.2.1.2	Tensile Strength, minimum	AS568-214 O-rings	1000 psi (6.90 MPa)	ASTM D1414
3.2.1.3	Elongation, minimum	AS568-214 O-rings	200%	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	Compression Set Percent of Original Deflection, maximum	AS568-214 O-rings	50	ASTM D395, Method B Temperature: 158 °F ± 2 °F (70 °C ± 1 °C) Time: 70 hours ± 0.5 hour
3.2.3	Volume Change	AS568-214 O-rings	0 - 10	ASTM D471 Ref. Fuel A Temperature: 73 °F ± 2 °F (23 °C ± 1 °C) Time: 72 hours ± 0.5 hour
3.2.4	Volume Change	AS568-214 O-rings	0 - 50	ASTM D471 Ref. Fuel B Temperature: 73 °F ± 2 °F (23 °C ± 1 °C) Time: 72 hours ± 0.5 hour
3.2.5	Temperature Retraction TR ₁₀ Point, maximum	AS568-214 O-rings	-50 °F (-46 °C)	ASTM D1329
3.2.6	Dry Neckdown Test	AS568-214 O-rings	Pass	4.4.1
3.2.7	Wet Neckdown Test	AS568-214 O-rings	Pass	4.4.2
3.2.8	Corrosion and Adhesion	AS568-214 O-rings	Slight corrosion okay on AMS6350 steel, none on other metals	4.4.3
3.2.9	Fourier Transform Infrared (FTIR)	AS568-214 O-rings	Record	ASTM D3677
3.2.10	Thermal Gravimetric Analysis (TGA)	AS568-214 O-rings	Record	ASTM E1131

3.3 Quality

All product, as received by purchaser, shall be as specified in the AS29512 or AS29513 parts standard, drawing or purchase document (see 1.3). Product as received by the purchaser, shall be uniform in quality and condition, smooth, as free from foreign material as commercially practicable, and free from internal imperfections detrimental to usage of the product. 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 AS29512 or AS29513 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 on-line 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.

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 AMS-P-5315 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 "A"	AS568-214 O-rings	65 ± 5	ASTM D2240
3.2.1.2	Tensile Strength, minimum	AS568-214 O-rings	1000 psi (6.90 MPa)	ASTM D1414
3.2.1.3	Elongation, minimum	AS568-214 O-rings	200%	ASTM D1414
3.2.1.4	Specific Gravity/Relative Density	AS568-214 O-rings	Preproduction Value ±0.02	ASTM D1414 (D297) Hydrostatic Method
3.2.3	Volume Change	AS568-214 O-rings	0 - 10	ASTM D471 Ref. Fuel A Temperature: 73 °F ± 2 °F (23 °C ± 1 °C) Time: 72 hours ± 0.5 hour
3.2.4	Volume Change	AS568-214 O-rings	0 - 50	ASTM D471 Ref. Fuel B Temperature: 73 °F ± 2 °F (23 °C ± 1 °C) Time: 72 hours ± 0.5 hour
3.2.6	Dry Neckdown Test	AS568-214 O-rings	Pass	4.4.1

4.2.2 Acceptance Lot Tests (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.

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 "A"	Part	65 ± 5	ASTM D2240
3.2.1.2	Tensile Strength, minimum	Part	1000 psi (6.90 MPa)	ASTM D1414
3.2.1.3	Elongation, minimum	Part	200%	ASTM D1414
3.2.1.4	Specific Gravity/Relative Density	Part	Preproduction Value ±0.02	ASTM D1414 (D297) Hydrostatic Method
3.2.3	Volume Change	Part	0 - 10	ASTM D471 Ref. Fuel A Temperature: 73 °F ± 2 °F (23 °C ± 1 °C) Time: 72 hours ± 0.5 hour
3.2.4	Volume Change	Part	0 - 50	ASTM D471 Ref. Fuel B Temperature: 73 °F ± 2 °F (23 °C ± 1 °C) Time: 72 hours ± 0.5 hour
3.2.6	Dry Neckdown Test	Part	Pass	4.4.1

4.2.3 Acceptance Lot Tests for All Other Seal Geometries Other Than O-rings and Plate Seals

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 plate seals and O-rings

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
3.2.4	Volume Change	AS568-214 O-rings	0 - 50	ASTM D471 Ref. Fuel B Temperature: 73 °F $\pm$ 2 °F (23 °C $\pm$ 1 °C) Time: 72 hours $\pm$ 0.5 hour

4.2.4 Acceptance 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.

4.2.4.1 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.

4.2.5 Lot

AS6414 as defined.

4.2.6 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.

4.2.7 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.

4.2.7.1 Material Traceability and Compound Confirmation

To provide full traceability of the compound being qualified and to ensure that the compound and the state of cure do not change during production, an FTIR spectra of a randomly chosen qualification part shall be obtained per ASTM D3677. This spectra, appropriately dated and recorded, shall remain part of the permanent record for the qualified compound. Copies of this record shall be available for reference. In addition, a TGA curve will be obtained for the same sample per ASTM E1131. This curve, showing compositional analysis, shall also be appropriately dated and recorded and shall remain part of the permanent record for the qualified compound.

4.2.7.2 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 Type 2 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 Type 2 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 Dry Neckdown Test

Test rings shall be stretched to 100% elongation and held in this condition by a suitable jig. The stretched samples shall demonstrate uniform cross section without local constrictions or other irregularities.

4.4.2 Wet Neckdown Test

Test rings shall be soaked for 16 to 24 hours in ASTM Reference Fuel B at 68 to 86 °F (20 to 30 °C), removed from the fuel, and visually examined within 15 minutes. The sample shall demonstrate uniform swell without distortion, angularity, or other local deviation from a uniform section.

4.4.3 Corrosion and Adhesion

Size -214 O-rings, two for each metallic plate below and using whole uncut rings, shall be prepared for corrosion testing by inserting sufficient quantities of the seals in a desiccator or similar humidity chamber maintained at relative humidity not lower than 92% and 77 °F ± 5 °F (25 °C ± 3 °C) for not less than 72 hours. Plates of the metals listed below shall be polished to a surface texture of 4 to 16 microinches (0.1 to 0.4 µm), determined in accordance with ASME 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:

AMS4027	Aluminum Alloy
AMS4037	Aluminum Alloy
AMS4045	Aluminum Alloy
AMS5513	Corrosion-Resistant Steel
AMS5630	Corrosion-Resistant Steel
AMS6350	Low-Alloy Steel

- 4.4.3.1 The humidified rings and the metallic plates shall be immersed in MIL-PRF-6083 fluid and drained to the drip point. The rings and plates shall be laid together in a stack so that at least two whole rings contact each specified metal. The stack shall be held together with a force of 20 to 30 lbf (89 to 133 N) and placed in a desiccator maintained at relative humidity not lower than 92% at 77 °F ± 5 °F (25 °C ± 3 °C). This relative humidity may be produced by using a salt of sufficient concentration in solution with distilled water. No more than 15 minutes should be required for assembling the test samples. Time of humidity exposure for this portion of test shall be 14 days. At the termination of this test, the procedures outlined below shall be followed: