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# AEROSPACE MATERIAL SPECIFICATION

AMS 7258

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Revised

## RINGS, SEALING, BUTADIENE-ACRYLONITRILE RUBBER
Fuel Resistant, Low Shrinkage
NBR Type, 65 - 75

1. SCOPE:

1.1 Form: This specification covers butadiene acrylonitrile (NBR) rubber in the form of molded rings.

1.2 Application: Sealing rings for use in aircraft fuel systems operating from -55° to +125°C (-65° to +255°F). These rings contain less plasticizer than normally used in aircraft fuel seals; therefore, there is less shrinkage when the rings are dried out. Standard sizes are as shown in AS 568.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications, Aerospace Standards, and Aerospace Information Reports shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Materials Specifications:

AMS 2350 - Standards and Test Methods
AMS 2817 - Packaging and Identification, Preformed Packings
AMS 3022 - Reference Fluid for Testing Hydrocarbon Fuel Resistant Materials, 10% Aromatic Content
AMS 4027 - Aluminum Alloy Sheet and Plate, 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr, (6061; -T6 Sheet, -T651 Plate), Solution and Precipitation Heat Treated
AMS 4037 - Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn, 2024; -T3 Flat Sheet, -T351 Plate
AMS 4045 - Aluminum Alloy Sheet and Plate, 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7075; -T6 Sheet, -T651 Plate), Solution and Precipitation Heat Treated
AMS 5513 - Steel Sheet, Strip, and Plate, Corrosion Resistant, 19Cr - 9.2Ni (SAE 30304), Solution Heat Treated
AMS 5630 - Steel Bars and Forgings, Corrosion Resistant, 17Cr - 0.5Mo (0.95 - 1.20C) (SAE 51440C)
AMS 6350 - Steel Sheet, Strip, and Plate, 0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)

2.1.2 Aerospace Standards:

AS 568 - Aerospace Size Standard for O-Rings
AS 871 - Manufacturing and Inspection Standards for Preformed Packings (O-Rings)

2.1.3 Aerospace Information Reports:

AIR 851 - O-Ring Tension Testing Calculations

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM D471 - Rubber Property - Effect of Liquids
ASTM D1414 - Testing Rubber O-Rings
ASTM D2240 - Rubber Property - Durometer Hardness

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Specifications:

QQ-A-250/4 - Aluminum Alloy 2024, Plate and Sheet
QQ-A-250/11 - Aluminum Alloy 6061, Plate and Sheet
QQ-A-250/12 - Aluminum Alloy 7075, Plate and Sheet

2.3.2 Military Specifications:

MIL-H-6083 - Hydraulic Fluid, Petroleum Base for Preservation and Operation
MIL-S-18729 - Steel Plate, Sheet, and Strip, Alloy 4130, Aircraft Quality

2.3.3 Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-413 - Visual Inspection Guide for Rubber O-Rings

2.4 ANSI Publications: Available from American National Standards Institute, 1430 Broadway, New York, NY 10018.

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

3. TECHNICAL REQUIREMENTS:

3.1 Material: Shall be a compound based on a butadiene acrylonitrile (NBR) elastomer, suitably cured to produce sealing rings meeting the requirements of 3.2.

3.2 Properties: Rings shall conform to the following requirements; except as otherwise specified, tests shall be performed in accordance with ASTM D1414, insofar as practicable. Calculations of tensile strength and elongation may be made in accordance with AIR 851.

3.2.1 As Received:

| | | | |
|---|---|---|---|
| 3.2.1.1 | Specific Gravity | Preproduction Value ±0.02 | |
| 3.2.1.2 | Hardness, Durometer "A" or equivalent | 70 ± 5 | ASTM D2240 |
| 3.2.1.3 | Tensile Strength, min | 1200 psi (8.25 MPa) | |
| 3.2.1.4 | Elongation, min | 200% | |
| 3.2.1.5 | Corrosion and Adhesion | Slight corrosion allowed on 4130 steel, none on other metals | 4.5.1 |

| | | | |
|---|---|---|---|
| 3.2.2 | Room Temperature Fuel Resistance: | | |
| 3.2.2.1 | Volume Change | 25 to 50% | Medium: ASTM Reference Fuel B<br>Temperature: 25°C ± 1 (77°F ± 2)<br>Time: 70 hr ± 0.5 |
| 3.2.3 | Elevated Temperature Fuel Resistance: | | 4.5.2<br>Medium: AMS 3022<br>Temperature: 125°C ± 3 (257°F ± 5)<br>Time: 70 hr ± 0.5 |
| 3.2.3.1 | Hardness Change, Durometer "A" or equivalent | -15 to 0 | |
| 3.2.3.2 | Tensile Strength change, max | -50% | |
| 3.2.3.3 | Elongation Change, max | -40% | |
| 3.2.3.4 | Volume Change | 15 to 40% | |
| 3.2.4 | Aliphatic Fuel Soak and Dry-out: | | 4.5.3<br>Medium: ASTM Reference Reference Fluid A |
| 3.2.4.1 | Volume Shrinkage, max | 1.0% | |
| 3.2.5 | Aromatic Fuel Soak and Dry-out: | | 4.5.3<br>Medium: ASTM Reference Fluid B |
| 3.2.5.1 | Volume Shrinkage, max | 1.0% | |
| 3.2.6 | Compression Set: Percent of Original Deflection, max | 60% | Temperature: 125°C ± 3 (257°F ± 5)<br>Time: 70 hr ± 0.5 |
| 3.2.7 | Low-Temperature Resistance Temperature Retraction, $TR_{10}$ point, max | | |
| 3.2.7.1 | As Received | -40°C (-40°F) | |
| 3.2.7.2 | After Aging 70 hr ± 0.5 at 25°C (77°F) in AMS 3022 | -60°C (-76°F) | |

3.3 Quality: Rings, as received by purchaser, shall be uniform in quality and condition, clean, smooth, as free from foreign material as commercially practicable, and free from imperfections detrimental to their performance. Surface imperfections shall be no greater than permitted by MIL-STD-413.

3.4 Sizes and Tolerances: Shall be as specified on the drawing. Inspection for conformance to dimensional requirements shall be made in accordance with AS 871.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of rings shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.6. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the rings conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to the following requirements are classified as acceptance tests and shall be performed on each lot:

| Requirement | Reference Paragraph |
|---|---|
| Specific Gravity as received | 3.2.1.1 |
| Hardness as received | 3.2.1.2 |
| Tensile Strength as received | 3.2.1.3 |
| Elongation as received | 3.2.1.4 |
| Volume Change in Reference Fuel B | 3.2.2.1 |
| Compression Set | 3.2.6 |
| Examination for Surface Imperfections | 3.3 |
| Sizes and Tolerances | 3.4 |

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed prior to or on the first-article shipment of rings to a purchaser, when a change in material, processing, or both requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling:

4.3.1 For Acceptance Tests: Sufficient rings shall be taken at random from each lot to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three. When specified, sample rings conforming to AS 568-214 and hardness discs shall be supplied with each lot.

4.3.1.1 Sample size for examination for appearance, workmanship, and dimensional conformance shall be in accordance with Inspection Level II of MIL-STD-105 and the AQL related to percent defective shall be 1.5.

4.3.1.2 A lot shall be all rings of the same size produced from the same batch of compound in one continuous series of operations and presented for vendor's inspection at one time but shall not exceed 1000 rings or 200 lb (90 kg), whichever is the greater mass. A lot may be packaged in small quantities under the basic lot approval provided lot identifications is maintained.

4.3.1.3 A batch shall be the quantity of compound run through a mill or mixer at one time.

4.3.1.4 When a statistical sampling plan and acceptance quality level (AQL) other than specified in 4.3.1.1, have been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1 and the report of 4.6 shall state that such plan was used.

4.3.1.5 If rings smaller than AS 568-010 are ordered, seven rings of -022 or -026 size shall be provided for determining tensile strength and elongation; such rings shall be from the same batch of compound, manufactured and, if required, post-cured under the same conditions as the production rings they represent.

4.3.1.6 Compression set shall be determined on not less than two rings.

4.3.2 For Preproduction Tests: Test samples shall be O-rings conforming in size to AS 568-214 and hardness discs of at least 1/4 in. (6.5 mm) thickness.

4.4 Approval:

4.4.1 Sample rings shall be approved by purchaser before rings for production use are supplied, unless such approval be waived by purchaser. Results of tests on production rings shall be essentially equivalent to those on the approved samples.

4.4.2 Vendor shall use ingredients, manufacturing procedures, processes, and methods of inspection on production rings which are essentially the same as those used on the approved sample rings. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in material, processing, or both and, when requested, sample rings. Production rings made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 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 25°C ± 3 (77°F ± 5) for not less than 72 hours. Plates of the metals listed below shall be polished to a surface texture of 4 to 16 microin. (0.1 - 0.4 μm), determined in accordance with ANSI 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 4037 or QQ-A-250/4 Aluminum Alloy
AMS 4027 or QQ-A-250/11 Aluminum Alloy
AMS 4045 or QQ-A-250/12 Aluminum Alloy
AMS 5630 - Corrosion Resistant Steel
AMS 5513 - Corrosion Resistant Steel
AMS 6350 or MIL-S-18729 Low-Alloy Steel

4.5.1.1 The humidified rings and the metallic plates shall be immersed in MIL-H-6083, Type I, 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 pressure of 20 - 30 lb (90 - 135 N) and placed in a desiccator maintained at relative humidity not lower than 92% at 25°C ± 3 (77°F ± 5). This relative humidity may be produced by the use of a salt of sufficient concentration in solution with distilled water. No more than 15 min. 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:

4.5.1.1.1 The surfaces of the plates which 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.

4.5.1.1.2 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 surfaces 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, visual examination at 10 to 15X magnification shall be used to determine the actual condition.

4.5.2 Fuel Aging: The containers used for high-temperature fuel aging shall be fuel-aging bombs constructed of corrosion-resistant steel. A typical container is shown assembled in Fig. 1 and unassembled in Fig. 2. The containers shall be filled with approximately 325 mL of fluid to within 1/2 in. (12.5 mm) of the top of the cylinder. The O-rings or hardness discs, or both, shall be suspended on nichrome wires at different depths in the fluid so that the O-rings are not in contact with other O-rings or any part of the container. Both an O-ring and a 0.005-in. (0.12 mm) thick teflon gasket cut to fit the container flange bolt circle shall be used for sealing during assembly of the fuel-aging bomb. The container top shall be bolted in place using six hexagon head bolts. At the end of the aging period, the fuel-aging bomb shall be removed from the heat source (aluminum block heater or circulating-air oven) and cooled for 60 min. ± 5 prior to disassembly. The O-rings and hardness discs shall be further cooled in new fluid for at least 30 min. at 25°C ± 2 (77°F ± 5) prior to properties testing.

4.5.3 Fuel Soak with Dry-Out, 3 Cycles: Two sets of three rings each shall be exposed to alternating fuel immersion and dry-out. One set shall be exposed to ASTM Reference Fuel A and the other set to ASTM Reference Fuel B. The O-rings shall be immersed in the applicable fuel for 70 hr ± 0.5 at 25°C ± 1 (77°F ± 2). The rings shall be removed from the fuel and allowed to dry at 25°C ± 1 (77°F ± 2) for 48 hr ± 0.5. The rings shall then be immersed in fresh fuel and dried out under the same conditions for a total of three cycles. Volume change, based on the original volume of the O-rings, shall be determined after each dry-out period. The results shall be averaged after each dry-out. The average of the three rings shall be not less than the maximum shrinkage of 1.0% at the end of any dry-out period.

4.6 Reports: The vendor of rings shall furnish with each shipment a report showing the results of tests to determine conformance to the acceptance test requirements and stating that the rings conform to the other technical requirements of this specification. This report shall include the purchase order number, AMS 7258, vendor's compound number, lot number, part number, and quantity.