Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 3229E
Superseding AMS 3229D
Issued 7-1-45
Revised 1-15-76

NITRILE RUBBER
Hot Oil Resistant, Low Swell
75 - 85

1. SCOPE:

1.1 Form: This specification covers a nitrile rubber in the form of sheet, strip, tubing, extrusions, and molded shapes.

1.2 Application: Primarily for packings, bushings and grommets in contact with hot, petroleum-base oils at temperatures from -40° to +100°C (-40°F to +212°F).

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

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc. 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2810 - Identification and Packaging, Elastomeric Products

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

ASTM D395 - Compression Set of Vulcanized Rubber
ASTM D412 - Tension Testing of Vulcanized Rubber
ASTM D471 - Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids
ASTM D573 - Accelerated Aging of Vulcanized Rubber by the Oven Method
ASTM D2137 - Low-Temperature Impact Test for Brittleness Determination of Flexible Polymeric Materials or Fabrics Coated Therewith, or Both
ASTM D2240 - Identation Hardness of Rubber and Plastics by Means of a Durometer

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

2.3.1 Military Standards:
MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Material: Shall be a compound based on a nitrile elastomer, suitably cured to produce a product Ø meeting the requirements of 3.2.

Ø 3.1.1 Color: Shall be black.

3.2 Properties: The product shall conform to the following requirements; tests shall be performed on the product supplied and in accordance with specified ASTM methods, insofar as practicable:

3.2.1 As Received:

Printed in U.S.A.

Ø 3.2.1.1 Hardness, Durometer "A" or equiv.	80 ± 5		ASTM D2240
3.2.1.2 Tensile Strength, min	1000 psi (6.9 MPa)		ASTM D412, Die B or C
3.2.1.3 Elongation, min	150%		ASTM D412, Die B or C
3.2.2 Lubricating Oil Resistance: (Immediate Deteriorated Properties)			ASTM D471
		Medium:	ASTM Oil No. 1
		Temperature:	150°C ± 3 (302°F ± 5.4)
3.2.2.1 Hardness Change, Durometer "A" or equiv.	-5 to +10	Time:	70 hr ± 0.5
3.2.2.2 Volume Change	0 to +10%		
3.2.2.3 Decomposition	None		
3.2.2.4 Surface Tackiness	None		
3.2.2.5 Bend 90 deg (1.57 rad) over radius 5 times specimen thickness	No cracking or checking		
3.2.3 Processing Oil Resistance: (Immediate Deteriorated Properties)			ASTM D471
		Medium:	ASTM Oil No. 3
		Temperature:	150°C ± 3 (302°F ± 5.4)
3.2.3.1 Hardness change, Durometer "A" or equiv.	-20 to +5	Time:	70 hr ± 0.5
3.2.3.2 Volume Change	0 to +45%		
3.2.3.3 Decomposition	None		
3.2.3.4 Surface Tackiness	None		
3.2.4 Compression Set:			ASTM D395, Method B
		Temperature:	125°C ± 1 (257°F ± 1.8)
3.2.4.1 Percent of Original Deflection, max	50	Time:	70 hr ± 0.5
3.2.5 Low Temperature Resistance:			ASTM D2137, Method A
		Temperature:	-40°C ± 1 (-40°F ± 1.8)
3.2.5.1 Brittleness	Pass	Time:	5 hr ± 0.2

3.2.6 Weathering: When specified, the product shall have weather resistance acceptable to the purchaser, determined by a procedure agreed upon by purchaser and vendor.

3.2.7 Corrosion: The product shall not have a corrosive effect on other materials when exposed to conditions normally encountered in service. Discoloration of metal shall not be considered objectionable.

3.3 Quality: The product shall be uniform in quality and condition, clean, smooth, as free from foreign Ø material as commercially practicable, and free from imperfections detrimental to fabrication, appearance, or performance of parts.

3.4 Tolerances: Unless otherwise specified, the following tolerances shall apply:

3.4.1 Sheet and Strip:

TABLE I

Nominal Thickness Inches	Tolerance, Inch plus and minus
Up to 0.125, incl	0.016
Over 0.125 to 0.500, incl	0.031
Over 0.500	0.047

TABLE I (SI)

Nominal Thickness Millimetres	Tolerance, Millimetres plus and minus
Up to 3.18, incl	0.41
Over 3.18 to 12.70, incl	0.79
Over 12.70	1.19

3.4.2 Tubing:

3.4.2.1 Diameter:

TABLE II

Nominal OD or ID (not both), Inches	Tolerance plus and minus	Ovality (See 3.4.2.1.1)
Up to 0.500, incl	0.020 in.	10
Over 0.500 to 1.000, incl	0.030 in.	15
Over 1.000	4%	15

TABLE II (SI)

Nominal OD or ID (not both) Millimetres	Tolerance plus and minus	Ovality, % (See 3.4.2.1.1)
Up to 12.70, incl	0.51 mm	10
Over 12.70 to 25.40, incl	0.76 mm	15
Over 25.40	4%	15

3.4.2.1.1 Ovality applies to tubing ordered in straight lengths with wall thickness of 0.063 in. (1.60 mm) and over, and shall be computed from the difference between the minor and major axis diameter measurements, taken at the same transverse plane on the tube, expressed as a percentage of the nominal diameter.

3.4.2.2 Wall Thickness:

TABLE III

Nominal Wall Thickness Inches	Tolerance plus and minus
Up to 0.063, excl	0.005 in.
0.063 and over	10%

TABLE III (SI)

Nominal Wall Thickness Millimetres	Tolerance plus and minus
Up to 1.60 excl	0.13 mm
1.60 and over	10%

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that the product conforms 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 or routine control tests and shall be performed on each lot of product:

Property	Paragraph
Hardness, as received	3.2.1.1
Tensile Strength, as received	3.2.1.2
Elongation, as received	3.2.1.3
Volume Change in Processing Oil	3.2.3.3
Compression Set	3.2.6

4.2.2 Qualification Tests: Tests to determine conformance to all technical requirements of this specification are classified as qualification or periodic control tests and may be the basis for approval of the compound (See 4.4.1).

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

4.3 Sampling: Sufficient material shall be taken from each lot to perform all required tests in triplicate. When the product supplied is an extrusion of such shape that suitable test specimens cannot be cut from the product, a separate flat strip test sample shall be supplied. This strip shall be prepared from tubing 1 in ± 0.063 (25 mm ± 1.60) in OD by 0.075 in. ± 0.008 (1.90 mm ± 0.20) in wall thickness, mechanically split and flattened into a strip while being extruded, and then cured in the same manner as production material.

4.3.1 A lot shall be all product from the same batch of compound processed in one continuous run and submitted for vendor's inspection at one time.

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

4.4 Approval:

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