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# AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3216D

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Superseding AMS 3216C

Submitted for recognition as an American National Standard

(R)

## FLUOROCARBON (FKM) RUBBER
## High-Temperature - Fluid Resistant
## Low Compression Set
## 70 to 80



1. SCOPE:

1.1 Form:

This specification covers a fluorocarbon (FKM) rubber in the form of sheet, strip, tubing, extrusions and molded shapes.

1.2 Application:

These products have been used typically in contact with air and a wide variety of fuels, synthetic lubricants, and specific hydraulic fluids from -29 to +260 °C (-20 to +500 °F), but usage is not limited to such applications. Each application however should be considered individually.

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 following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.



QUESTIONS REGARDING THIS DOCUMENT: (412) 772-7154 FAX: (412) 776-0243
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2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2279 Tolerances, Rubber Products
MAM 2279 Tolerances, Metric Rubber Products
AMS 2810 Identification and Packaging, Elastomeric Products
AMS 3023 Fluid, Reference, for Testing Polyol Ester (and Diester) Resistant Materials

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 297 Rubber Products - Chemical Analysis
ASTM D 395 Rubber Property - Compression Set
ASTM D 412 Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 471 Rubber Property - Effect of Liquids
ASTM D 573 Rubber Property - Deterioration in an Air Oven
ASTM D 792 Rubber Property - Specific Gravity
ASTM D 1329 Rubber Property - Retraction at Low Temperature (TR Test)
ASTM D 2240 Rubber Property - Durometer Hardness

3. TECHNICAL REQUIREMENTS:

3.1 Material:

Shall be a compound, based on a fluorocarbon (FKM) elastomer, suitably cured to produce a product meeting the requirements of 3.2. A dihydroxy/bisphenol cure system shall be used. Material shall be based on 100% virgin fluorocarbon (FKM) elastomer. No reprocessed or non-fluorocarbon polymer is acceptable.

3.1.1 Color: Shall be black or brown. No other color shall be acceptable.

3.2 Properties:

The product shall conform to the requirements shown in Table 1 and Table 2; tests shall be performed on the product supplied and in accordance with ASTM Test Methods, insofar as practicable.

TABLE 1 - Properties

| Property | Requirement | Test Method |
|---|---|---|
| 3.2.1 Hardness, Durometer "A" or equivalent | 75 ± 5 | ASTM D 2240 |
| 3.2.2 Tensile Strength, min | 1600 psi (11.02 MPa) | ASTM D 412 |
| 3.2.3 Elongation, min | 125% | ASTM D 412 |
| 3.2.4 Specific Gravity | Preproduction Value ±0.02 | ASTM D 792 (Hydrostatic Method) |
| 3.2.5 Aromatic Fuel Resistance | | ASTM D 471<br>ASTM Ref. Fuel B<br>23 °C ± 2<br>(73 °F ± 5)<br>70 hours ± 0.5 |
| 3.2.5.1 Hardness Change, Durometer "A" or equivalent | –5 to +5 | |
| 3.2.5.2 Tensile Strength Change, max | –20% | |
| 3.2.5.3 Elongation Change, max | –20% | |
| 3.2.5.4 Volume Change | 0 to +5% | |
| 3.2.6 Synthetic Lubricant Resistance | | ASTM D 471 (Note A)<br>AMS 3023<br>200 °C ± 3<br>(392 °F ± 5)<br>70 hours ± 0.5 |
| 3.2.6.1 Hardness Change, Durometer "A" or equivalent | –15 to 0 | |

TABLE 1 - Properties (Continued)

| Property | Requirement | Test Method |
|---|---|---|
| 3.2.6.2 Tensile Strength Change, max (based on area before immersion) | –35% | |
| 3.2.6.3 Elongation Change, max | –20% | |
| 3.2.6.4 Volume Change | +1 to +25% | |
| 3.2.6.5 Compression Set, Percent of Original Deflection, max | 20 | ASTM D 395 Method B |
| 3.2.7 Dry Heat Resistance | | ASTM D 573<br>270 °C ± 3<br>(518 °F ± 5)<br>70 hours ± 0.5 |
| 3.2.7.1 Hardness Change, Durometer "A" or equivalent | –5 to +10 | |
| 3.2.7.2 Tensile Strength Change, max | –35% | |
| 3.2.7.3 Elongation Change, max | –15% | |
| 3.2.7.4 Weight Loss, max | 10% | 4.5.1 |
| 3.2.8 Compression Set: Percent of Original Deflection, max | 15 | ASTM D 395<br>Method B<br>200 °C ± 3<br>(392 °F ± 5)<br>22 hours ± 0.5 |
| 3.2.9 Long-Term Compression Set: Percent of Original Deflection, max | 45 | 200 °C ± 3<br>(392 °F ± 5)<br>336 hours ± 0.5 |

TABLE 1 - Properties (Continued)

| Property | | Requirement | Test Method |
|---|---|---|---|
| 3.2.10 | Low-Temperature Resistance Temperature Retraction, TR, Point, max | -15 °C (+5 °F) | ASTM D 1329 |

(Note A) Do not dip specimen in acetone; blot dry residual oil from specimen.

3.2.11 Physical Properties After Humidity Aging on Brown Material Only: The following properties shall be determined on brown specimens that have been aged for 28 days ± 2 hours at 25 °C ± 2 (77 °F ± 5) and 95% ± 3 relative humidity.

TABLE 2 - Humidity Aged Properties

| Property | | Requirement | Test Method |
|---|---|---|---|
| 3.2.11.1 | Tensile Strength, min | 1600 psi (11.02 MPa) | |
| 3.2.11.2 | Elongation, min | 125% | |
| 3.2.11.3 | Tensile Strength Change, max (1) | -15% | |
| 3.2.11.4 | Elongation Change, max (1) | -15% | |
| 3.2.12 | Synthetic Lubricant Resistance | | ASTM D 471 (Note A)<br>AMS 3023<br>200 °C ± 3<br>(392 °F ± 5)<br>70 hours ± 0.5 |
| 3.2.12.1 | Tensile Strength Change, max | –35% | |
| 3.2.12.2 | Elongation Change, max | –20% | |

TABLE 2 - Humidity Aged Properties (Continued)

| Property | Requirement | Test Method |
|---|---|---|
| 3.2.12.3 Compression Set: Percent of Original Deflection, max | 15 | |
| 3.2.13 Dry Heat Resistance After Humidity Age | | ASTM D 573<br>270 °C ± 3<br>(518 °F ± 5)<br>70 hours ± 0.5 |
| 3.2.13.1 Tensile Strength Change, max | –35% | |
| 3.2.13.2 Elongation Change, max | –25% | |
| 3.2.14 Compression Set Percent of Original Deflection, max | 15 | ASTM 395<br>Method B<br>200 °C ± 3<br>(392 °F ± 5)<br>22 hours ± 0.5 |

Note A: Do not dip specimen in acetone; blot dry residual oil from specimen.

(1) Shall be based on the original tensile strength and elongation found when tested to the requirements of Table 1.



3.3 Quality:

Products, as received by purchaser, shall be uniform in quality and condition, smooth as free from foreign material, and free from internal imperfections detrimental to usage of the product.

3.4 Sizes and Tolerances:

Shall conform to all applicable requirements of AMS 2279 or MAM 2279.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

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

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Requirements shown in Table 3 are acceptance tests and shall be performed on each lot.

TABLE 3 - Acceptance Requirements

| Requirements | Paragraph Reference |
|---|---|
| Hardness | 3.2.1 |
| Tensile Strength | 3.2.2 |
| Elongation | 3.2.3 |
| Specific Gravity | 3.2.4 |
| Compression Set | 3.2.8 |
| Quality | 3.3 |



4.2.2 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of the product by the manufacturer or when a change in ingredients and/or processing requires reapproval as in 4.4.2 and when purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

Shall be as follows:

4.3.1 Acceptance Tests: Sufficient product shall be taken at random from each lot to perform all the required tests. The number of determinations for each requirement shall be as specified except as otherwise specified in 4.3.1.4 in the applicable test procedure or, if not specified therein, not less than three.

4.3.1.1 If specimens cannot be prepared from the product, ASTM test specimens prepared from the same batch and state of cure shall be used. 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 from the same production lot shall be supplied upon request. This strip shall be prepared from the tubing 1.000 inch ± 0.063 (25.40 mm ± 0.20) in wall thickness, mechanically slit and flatten into a strip while being extruded and cured in the same manner as the production product. When the product is a molded shape from which test specimens cannot be cut, a slab 6 inches (152 mm) square by 0.075 inch ± 0.008 (1.90 mm ± 0.020) thick molded from the same batch of compound shall be supplied upon request.

4.3.1.2 A lot shall be all product produced from the same batch of compound processed in one continuous run and presented for manufacturers inspection at one time.

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 A statistical sampling plan acceptable to the purchaser may be used in lieu of sampling as in 4.3.1. Sample size for visual and dimensional requirements shall be as shown in Table 4; sample unit shall be one molded part and acceptable based on zero defects.



TABLE 4 - Visual and Dimensional Inspection

| Lot Size | Sample Size |
|---|---|
| 2 to 8 | Entire Lot |
| 9 to 90 | 8 |
| 91 to 150 | 12 |
| 151 to 280 | 19 |
| 281 to 500 | 21 |
| 501 to 1200 | 27 |
| 1201 to 3200 | 35 |
| 3201 to 10,000 | 38 |
| 10,001 to 35,000 | 46 |
| 35,001 to 150,000 | 56 |
| 150,001 and Over | 65 |

4.3.2 Preproduction Tests: Acceptable to purchaser or as stated in the contract.