AERONAUTICAL MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
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AMS 3221 A

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SYNTHETIC RUBBER
Rapid Fuel Swelling (45-55)

1. ACKNOWLEDGMENT: A vendor must mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

2. FORM: Sheet, strip, tubing, extrusions, molded shapes, or as ordered.

3. APPLICATION: The compound shall be suitable for fuel seals.

4. QUALITY: (a) It shall be uniform in quality, free from foreign materials or imperfections, tough and not easily torn by hand. It shall resist the solvent action of aircraft engine fuels.

(b) Parts must be smooth and free from flash.

(c) If rings have a vulcanized joint, the joint section must have the same strength and size as the solid section.

5. REQUIREMENTS: (a) Physical Properties.- This material shall possess the following physical properties as received:

Shore Durometer "A" Hardness	50±5
Tensile Strength, lb per sq in.	1500 min
Elongation, %	400 min

All tensile tests required by this and succeeding paragraphs shall conform to ASTM D412-41, except that physical properties after all aging tests shall be based on the original unaged cross-sectional area.

(b) Fuel Aging.- Tests shall be conducted in accordance with ASTM D471-40T, except that physical properties after aging shall be determined immediately after removal from the fuel. Test conditions shall be as follows:

Medium	Aromatic Blended Fuel:	62 Octane Gasoline	60%
		Toluol	20%
		Xylol	15%
		Benzol	5%
Time	30 minutes, 24 and 168 hours.		
Temperature	70°-85°F		

After the 24-hour aging period, the elongation shall have decreased not more than 50% from the values found for the material as received. The Shore Durometer "A" hardness change shall be within the limits of 0 to -20 points. The volume change shall be +25% minimum in 30 minutes, and within the limits of +50 to +150% at the end of the 24-hour aging period. After aging for 168 hours, the volume change shall be not more than +150% and not less than 95% of the percentage change after 24 hours.

(c) Extraction.- Tests shall be conducted in general accordance with ASTM D297-41T, Section 12, using benzol as the extractant. The sample shall be dried before extraction, cut into strips, and extracted until the benzol siphons over clear. The sample shall then be dried free of all extractant, and the extracted volume and weight shall be determined. The weight of the sample shall have decreased not more than 7.5%. The volume also shall have decreased not more than 7.5%. Extracted samples, after immersion in aromatic blended fuel as in paragraph 5(b) above for 30 minutes, shall show a volume increase of not less than 20% using the original unextracted volume as the base.

(d) Oven Aging.- Tests shall be conducted in accordance with ASTM D573-41 for 70 hours at 212°±2°F. After aging, the surface shall be neither hard nor brittle, and specimens shall withstand bending 180° flat without cracking. The Shore Durometer "A" hardness change shall be within the limits of 0 to +10 points. The tensile strength shall have decreased by not more than 40% and the elongation by not more than 50% from the values found for the material as received.

(e) Compression Set.- Tests shall be conducted in accordance with ASTM D395-40T, Method B, under the following conditions:

Time	70 hours
Temperature	212° ± 2°F
Compression, To	70% of original thickness

(1) The maximum compression set shall be 85% when expressed as a percentage of the original deflection.

(2) The maximum compression set shall be 26% when expressed as a percentage of the original thickness.

NOTE: In lieu of the compression set above, the tension set may be determined in accordance with ASTM D412-41. The permanent set shall not exceed 10%.

(f) Cold Aging.- The cold resistance of the material shall be determined by the SAE-ASTM Bent Loop Method, which is as follows:

The specimen, a strip 4" x 1/4" x .075", is clamped in a loop position between plates 2-1/2" apart and at least 2" wide in such a manner that the bend in the test piece does not protrude beyond the edges when the plates are brought together, and that the ends are held for not more than 1/4". After exposure to cold dry air for the specified time and temperature, the jaws are rapidly brought together until they are 1" apart.

Medium	Dry Air
Time	5 hours
Temperature	-40°F

After this test the specimen shall show no signs of cracking.

6. SAMPLES: Sampling procedures shall conform to ASTM D15-41. When the form in which the material is furnished is unsuitable for the proper preparation of the test specimens required, the vendor shall furnish sufficient material for such specimens from production-run materials which he guarantees to be of equal quality to the material supplied.

7. TOLERANCES: Unless otherwise specified on the drawing or purchase order, the following tolerances apply; all dimensions are in inches:

(a) Sheet and Strip.-

Nominal Thickness	Tolerance plus or minus
1/8 and less	1/64
Over 1/8 to 1/2 incl.	1/32
Over 1/2	3/64

(b) Tubing and Molded Hose.-

Nominal Wall Thickness	Tolerance plus or minus
Less than 1/16	0.005
1/16 and over	10%

(c) Extrusions and Molded Parts.- Sections may be as much as plus or minus 0.005 inch outside of drawing limits provided the cross-sectional area is within the limits given by the drawing dimensions.

8. REPORTS: Unless otherwise specified, the vendor shall furnish three copies of a notarized report of the results of tests to determine conformance to this specification. This report shall include the purchase order number, material specification number, vendor's compound number, percentages and specific type of synthetic or synthetics used, part number and quantity.

9. IDENTIFICATION: (a) Sheets.- Unless otherwise specified, each sheet shall be marked to show the manufacturer's identification, Predominant Polymer Symbol, Formula Number, AMS 3221, and the thickness in inches. The characters shall be not less than 3/8 inch in height and shall be applied in rows of constantly recurring symbols from one edge of the sheet to the opposite edge with rows spaced approximately 5 inches apart. The characters shall be clearly legible, and shall be applied to the material by suitable means and suitable marking fluid, and shall not be obliterated by normal handling.

(b) Extrusions and Molded Tubes.- Where the shape and nature of the material permit, mark the stock consecutively with information (excepting thickness) and methods as given in 9(a) above. The characters shall be of such size as to be clearly legible.

(c) Where the shape and nature of the materials, either extrusions, molded forms or strip stock do not permit of the above marking, the identification shall appear on the package as in paragraph 10(b) below.

(d) Other forms shall be identified as agreed by the vendor and the purchaser.

10. PACKAGING AND MARKING: (a) Packaging shall be accomplished in such a manner as to insure that the materials being shipped will not be permanently distorted or compressed, or be exposed to undue weathering, or harmful materials of any kind.